

FORM PTO-1390
(REV. 5-93)U.S. DEPARTMENT OF COMMERCE
PATENT AND TRADEMARK OFFICEATTORNEY'S DOCKET NUMBER
10191/1661**TRANSMITTAL LETTER TO THE UNITED STATES
DESIGNATED/ELECTED OFFICE (DO/EO/US)
CONCERNING A FILING UNDER 35 U.S.C. 371**

U.S. APPLICATION NO. (If known, see 37 CFR 1.5)

09/743305INTERNATIONAL APPLICATION NO.
PCT/DE00/01426INTERNATIONAL FILING DATE
(05.05.00)
05 May 2000PRIORITY DATES CLAIMED
(08.05.99)
08 May 1999

TITLE OF INVENTION

METHOD AND DEVICE FOR MONITORING THE INTERIOR AND SURROUNDING AREA OF A VEHICLE

APPLICANT(S) FOR DO/EO/US

KOENIG, Winfried; HÜRTGEN, Bernd; and PÖCHMÜLLER, Werner

Applicant herewith submits to the United States Designated/Elected Office (DO/EO/US) the following items and other information

1. ☒ This is a **FIRST** submission of items concerning a filing under 35 U.S.C. 371.
 2. ☐ This is a **SECOND** or **SUBSEQUENT** submission of items concerning a filing under 35 U.S.C. 371.
 3. ☒ This express request to begin national examination procedures (35 U.S.C. 371(f)) immediately rather than delay examination until the expiration of the applicable time limit set in 35 U.S.C. 371(b) and PCT Articles 22 and 39(1).
 4. ☐ A proper Demand for International Preliminary Examination was made by the 19th month from the earliest claimed priority date.
 5. ☒ A copy of the International Application as filed (35 U.S.C. 371(c)(2))
 - a. ☐ is transmitted herewith (required only if not transmitted by the International Bureau).
 - b. ☒ has been transmitted by the International Bureau.
 - c. ☐ is not required, as the application was filed in the United States Receiving Office (RO/US)
 6. ☒ A translation of the International Application into English (35 U.S.C. 371(c)(2)).
 7. ☒ Amendments to the claims of the International Application under PCT Article 19 (35 U.S.C. 371(c)(3))
 - a. ☐ are transmitted herewith (required only if not transmitted by the International Bureau).
 - b. ☐ have been transmitted by the International Bureau.
 - c. ☐ have not been made; however, the time limit for making such amendments has NOT expired.
 - d. ☒ have not been made and will not be made.
 8. ☐ A translation of the amendments to the claims under PCT Article 19 (35 U.S.C. 371(c)(3)).
 9. ☒ An oath or declaration of the inventor(s) (35 U.S.C. 371(c)(4)) (UNSIGNED).
 10. ☐ A translation of the annexes to the International Preliminary Examination Report under PCT Article 36 (35 U.S.C. 371(c)(5)).
- Items 11. to 16. below concern other document(s) or information included:**
11. ☒ An Information Disclosure Statement under 37 CFR 1.97 and 1.98.
 12. ☐ An assignment document for recording. A separate cover sheet in compliance with 37 CFR 3.28 and 3.31 is included.
 13. ☒ A **FIRST** preliminary amendment.
☐ A **SECOND** or **SUBSEQUENT** preliminary amendment.
 14. ☐ A substitute specification.
 15. ☐ A change of power of attorney and/or address letter.
 16. ☒ Other items or information: Copies of International Search Report and Form PCT/RO/101.

EXPRESS NO.

EL 594610404US

09/743303

17. ☒ The following fees are submitted:**Basic National Fee (37 CFR 1.492(a)(1)-(5)):**

Search Report has been prepared by the EPO or JPO \$860.00

International preliminary examination fee paid to USPTO (37 CFR 1.482) ... \$690.00

No international preliminary examination fee paid to USPTO (37 CFR 1.482) but
international search fee paid to USPTO (37 CFR 1.445(a)(2)) \$750.00Neither international preliminary examination fee (37 CFR 1.482) nor international
search fee (37 CFR 1.445(a)(2)) paid to USPTO \$1000.00
International preliminary examination fee paid to USPTO (37 CFR 1.482) and all
claims satisfied provisions of PCT Article 33(2)-(4) \$100.00

CALCULATIONS | PTO USE ONLY

ENTER APPROPRIATE BASIC FEE AMOUNT = \$860Surcharge of \$130.00 for furnishing the oath or declaration later than ☐ 20 ☐ 30 months
from the earliest claimed priority date (37 CFR 1.492(e)).

\$

Claims	Number Filed	Number Extra	Rate		
Total Claims	36 - 20 =	16	X \$18.00	\$ 288	
Independent Claims	2 - 3 =	0	X \$80.00	\$ 0	
Multiple dependent claim(s) (if applicable)			+ \$270.00	\$	

TOTAL OF ABOVE CALCULATIONS = \$1148Reduction by 1/2 for filing by small entity, if applicable. Verified Small Entity statement must
also be filed. (Note 37 CFR 1.9, 1.27, 1.28).

\$

SUBTOTAL = \$1148Processing fee of \$130.00 for furnishing the English translation later the ☐ 20 ☐ 30
months from the earliest claimed priority date (37 CFR 1.492(f)).

+

\$

TOTAL NATIONAL FEE = \$1148Fee for recording the enclosed assignment (37 CFR 1.21(h)). The assignment must be
accompanied by an appropriate cover sheet (37 CFR 3.28, 3.31). \$40.00 per property

+

\$

TOTAL FEES ENCLOSED = \$1148Amount to be:
refunded \$
charged \$

- a. ☐ A check in the amount of \$_____ to cover the above fees is enclosed.
- b. ☒ Please charge my Deposit Account No. 11-0600 in the amount of **\$1148.00** to cover the above fees. A duplicate copy of this sheet is enclosed.
- c. ☒ The Commissioner is hereby authorized to charge any additional fees which may be required, or credit any overpayment to Deposit Account No. 11-0600. A duplicate copy of this sheet is enclosed.

NOTE: Where an appropriate time limit under 37 CFR 1.494 or 1.495 has not been met, a petition to revive (37 CFR 1.137(a) or (b)) must be filed and granted to restore the application to pending status.

SEND ALL CORRESPONDENCE TO:

Kenyon & Kenyon
One Broadway
New York, New York 10004

SIGNATURE

Richard L. Mayer, Reg. No. 22,490

NAME

DATE

09/743305

534 Rec'd PCT/PTO 08 JAN 2001

[10191/1661]

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Inventor(s) : Winfried KOENIG et al.
Serial No. : To Be Assigned
Filed : Herewith
For : METHOD AND DEVICE FOR MONITORING THE
INTERIOR AND SURROUNDING AREA OF A VEHICLE
Examiner : To Be Assigned
Art Unit : To Be Assigned

Assistant Commissioner
for Patents
Washington, D.C. 20231

PRELIMINARY AMENDMENT

SIR:

Kindly amend the above-identified application before
examination, as set forth below.

IN THE TITLE:

Please replace the title with the following new
title:

--METHOD AND DEVICE FOR MONITORING THE INTERIOR AND
SURROUNDING AREA OF A VEHICLE--.

IN THE DRAWINGS:

Please amend the drawings as indicated on the
attached red-marked sheets.

IN THE SPECIFICATION:

Please amend the specification as follows.

On page 1, delete lines 1-3, and insert:

--FIELD OF THE INVENTION

The present invention relates to a method and device for
monitoring the interior and surrounding area of a vehicle.

BACKGROUND INFORMATION

The article "Die--.

EL594610404US

On page 1, line 5, change "in" to --published in the October 1998 issue of--.

On page 1, line 6, delete "October 1998 issue, page 8;--".

On page 1, line 9, delete "then".

On page 1, line 10, change "image, which are then" to --Then, the road signals are--.

On page 1, line 15, change "which" to --that--.

On page 1, line 16, delete "which".

On page 1, line 18, change "known from" to --described in PCT Patent No.--.

On page 1, delete line 21, and insert:
--SUMMARY--.

On page 1, line 22, change "By contrast, the" to --The--.

On page 1, delete line 23, and insert:
--has the--.

On page 1, line 24, change "as well as" to --and--.

On page 2, line 4, delete "particularly".

On page 2, line 8, change "only" to --is--.

On page 2, line 9, change "which" to --that--.

On page 2, line 11, delete "particularly".

On page 2, line 12, change "preferably" to --for
example--.

On page 2, line 18, change "of the interior; a" to
--the interior. A--.

On page 2, line 24, delete "in particular".

On page 2, line 25, change "In particular" to --For
example--.

On page 2, line 29, change "Thus" to --Thus,--.

On page 2, line 32, change "source" to --source,--.

On page 2, line 33, change "which" to --that--.

On page 3, line 4, change "terms, which" to --terms.
This--.

On page 3, line 6, delete "particularly", and change
"carry out" to --perform--.

On page 3, line 7, change "switching" to --switch--.

On page 3, line 10, change "in particular" to --for
example--.

On page 3, line 18, change "In particular" to --For
example--.

On page 3, line 19, change "carried out" to
--performed--.

On page 3, delete line 30, and insert:
--for example his eyes, the road markings, and--.

On page 3, line 31, delete "respectively,".

On page 3, line 32, change "markings; this is because this" to --markings. This--.

On page 3, line 35, change "which" to --that--.

On page 3, line 36, change "Thus, because" to --Since--, and delete "additional".

On page 3, line 37, change "safety compared to the related art" to --safety, as compared to conventional methods and devices--.

On page 4, line 1, change "achieved" to --increased--.

On page 4, line 3, change "some" to --a--.

On page 4, line 12, change "Because" to --Since--.

On page 4, line 13, delete "because".

On page 4, line 28, after "for" insert --an--.

On page 4, line 30, change "namely" to --for example--.

On page 4, line 32, change "heater" to --heater,--, and change "using" to --sitting--.

On page 4, line 33, change "In particular" to --For example--.

On page 5, line 5, change "preferably" to --for example--.

On page 5, line 7, change "unclear" to --unclear,--.

On page 5, line 15, change "carrying" to --performing--.

On page 5, line 16, delete "out".

On page 5, line 18, delete "so as".

On page 5, line 19, delete "of" (second occurrence).

On page 5, line 20, change "In particular" to --For example--.

On page 5, line 23, change "preferably" to --for example--.

On page 6, line 1, change "as" to --as, for example,--.

On page 6, line 4, delete "particularly".

On page 6, line 8, change "objects" to --objects,--.

On page 6, line 15, delete "of".

On page 6, line 20, delete "particularly".

On page 6, delete lines 32-37, and insert:

--BRIEF DESCRIPTION OF THE DRAWINGS

Figure 1 shows an arrangement of a device according to the present invention in a motor vehicle.

Figure 2 shows a flow chart of a first embodiment of a method according to the present invention.

Figure 2a shows a first process step of a method according to

the present invention.

Figure 2b shows a second process step of a method according to the present invention.

Figure 2c shows an evaluation method according to the present invention.

Figure 3 shows a flow chart for a second embodiment of a method according to the present invention.

Figure 4 shows a first embodiment of a device according to the present invention.

Figure 5 shows a second embodiment of a device according to the present invention.

Figure 6 shows a third embodiment of a device according to the present invention.

Figure 7 shows a fourth embodiment of a device according to the present invention.

Figure 8a shows a first embodiment of a deviation mirror according to the present invention.

Figure 8b shows a second embodiment of a deviation mirror according to the present invention.

DETAILED DESCRIPTION--.

On page 7, delete lines 1-14.

On page 7, line 18, change "13, a" to --13. A--, and change "leading" to --leads--.

On page 7, line 21, change "opposite side" to --

side--, and after "10" insert --opposite--.

On page 7, line 23, change "Second" to --Therefore, second--.

On page 7, line 24, delete "therefore only".

On page 7, line 31, change "preferably embodied as" to --embodied as, for example,--.

On page 7, line 33, change "In particular" to --For example--.

On page 7, line 37, change "unit" to --unit,--.

On page 8, line 2, change "either be arranged in" to --be arranged in, for example, either--.

On page 8, line 3, delete "or in".

On page 8, line 4, delete "in".

On page 8, line 5, change "a preferred" to --an--.

On page 8, line 17, change "Preferably" to --Therefore,--, and delete "therefore".

On page 8, line 18, change "arranged" to --arranged, for example,--.

On page 8, line 34, change "unit, a" to --unit. A--, and change "being output" to --is output--.

On page 9, line 2, change "35, in which" to --35. In second process step 34,--.

On page 9, line 5, change "previously," to

--previously. Image information regarding the vehicle interior is determined--.

On page 9, line 8, delete "obtained", and change "also output" to --obtained and output--.

On page 9, line 9, change "media, the second output being in particular" to --media. The second output is--.

On page 9, line 12, delete "in".

On page 9, line 13, delete "particular".

On page 9, line 31, delete "of".

On page 9, line 33, change "carried out" to --performed--.

On page 10, line 8, change "which" to --that--.

On page 10, line 9, change "device and of" to --device,--.

On page 10, line 10, change "33" to --33,--.

On page 10, line 34, change "carried out" to --performed--.

On page 11, line 13, change "preferably" to --for example--.

On page 11, line 23, change "carried out" to --performed--.

On page 11, line 25, after "60," insert --and--.

On page 11, line 26 change "being" to --is--.

On page 12, line 16, change "carried out" to --performed--.

On page 12, line 27, after "vehicle" insert --and--.

On page 13, line 5, change "carried out" to --performed--.

On page 13, line 9, change "preferred" to --an--.

On page 13, line 14, change "Particularly" to --For example,--.

On page 13, line 22, change "having" to --that has--.

On page 13, line 24, change "as" to --as, for example,--.

On page 14, line 11, change "housing which is preferably" to --housing, which, for example, is--.

On page 14, line 25, change "a preferred" to --an--.

On page 14, line 28, change "in" to --of--.

On page 14, line 34, delete "preferably".

On page 14, line 36, change "carried out" to --performed--.

On page 15, line 2, change "captured, this" to --captured. This--.

On page 15, line 3, change "being" to --is--.

On page 15, line 7, change "Preferably the" to

--The--, and change "as" to --as, for example,--.

On page 15, line 14, change "through infra-red radiation" to --infra-red radiation through--.

On page 15, line 16, change "Thus in particular" to --Thus, for example,--.

On page 15, line 18, delete "thus".

On page 15, line 28, change "interior" to --interior,--.

On page 15, line 30, change "100" to --100,--.

On page 16, line 4, change "mean" to --include--.

On page 16, line 6, change "which mean that" to --since--, and after "seen" insert --by--.

On page 16, line 7, change "mean" to --include--.

On page 16, line 8, change "as" to --as, for example,--.

On page 17, line 1, change "a preferred" to --an--.

On page 17, line 21, change "as" to --as, for example,--.

On page 17, line 30, change "carrying out" to --performing--.

On page 18, line 13, change "provided," to --provided that--.

On page 18, line 32, change "is" to --are--.

On page 19, line 2, change "cameras" to
--cameras,--.

On page 19, line 3, change "another" to
--another,--.

On page 19, line 21, change "thanks" to --due--.

IN THE ABSTRACT:

Please amend the Abstract as follows.

Delete line 1, and insert:

--
ABSTRACT--.

Line 3, change "the area surrounding" to --a
surrounding area--.

Line 4, change "is" to --are--.

Line 5, change "carrying out" to
--performing--, and change "(10) having" to --that has--.

Line 6, delete "(103)", and change "the direction of
the" to --a direction of the surrounding--.

Line 7, change "surrounding" to --of--, and change
"the road, and having" to --a road, and has--.

Line 8, delete "(108)", and change "the direction"
to --a direction--.

Line 9, delete "(110)".

IN THE CLAIMS:

On page 20, delete line 1, and insert:
--What Is Claimed Is:--.

Please cancel claims 1-26, without prejudice.

Please add the following new claims:

26. (New) A method for monitoring an interior of a motor vehicle and a surrounding area of the motor vehicle, comprising:

(1) capturing an image of at least part of the surrounding area of the motor vehicle by a camera device;

(2) capturing an image of at least part of the interior of the motor vehicle by the camera device, the steps (1) and (2) being performed alternately; and

(3) transmitting the images obtained in steps (1) and (2) to a processing unit.

27. (New) The method according to claim 26, wherein:

the at least part of the surrounding area of the vehicle is in a direction of travel.

28. (New) The method according to claim 26, wherein:

the at least part of the interior of the vehicle includes parts of a body of a driver.

29. (New) The method according to claim 26, wherein step (1) includes illuminating the interior of the vehicle by a radiation source, the radiation source emitting a radiation at least substantially invisible to the human eye.

30. (New) The method according to claim 29, wherein:

the radiation source is an infra-red radiation source.

31. (New) The method according to claim 26, wherein step (2) includes:

superimposing the at least part of the interior of the vehicle visible to the camera device on the at least part of the surrounding area of the vehicle visible to the camera device; and

determining the image of the at least part of the interior of the vehicle by subtracting the image of the at least part of the surrounding area.

32. (New) The method according to claim 26, wherein:
only an image of an area surrounding the motor vehicle visible to the camera device is captured in the step (1); and
only an image of the interior of the motor vehicle visible to the camera device is captured in the step (2).
33. (New) The method according to claim 32, wherein:
switching back and forth between the step (1) the step (2) is accomplished via at least one light valve.
34. (New) The method according to claim 33, wherein:
the at least one light valve is an electro-optical light valve.
35. (New) The method according to claim 26, wherein an image captured is only a partial area of a maximum image that may be captured by the camera device, the partial area of the maximum image including at least one of image rows, image columns, and image pixels, and wherein the method further comprises:
switching back and forth between capturing a partial area of the interior and a partial area of the surrounding area;
processing by the processing unit the partial areas captured; and
capturing a next partial area.
36. (New) The method according to claim 26, further comprising:
capturing a face of a driver, the face including eyes of the driver.
37. (New) The method according to claim 26, further

comprising:

capturing at least one of road markings and a position of the vehicle relative to the road markings.

38. (New) The method according to claim 36, further comprising:

evaluating at least one of the face of the driver and a position of the vehicle relative to road markings to determine at least one of whether the eyes of the driver are open and whether the vehicle is moving beyond a predefined area of the road markings; and

issuing at least one of a visual warning and an audible warning based on the evaluation.

39. (New) The method according to claim 26, further comprising:

capturing road signs.

40. (New) The method according to claim 26, further comprising:

determining at least one of a number of people in the vehicle and a seat occupancy.

41. (New) The method according to claim 40, further comprising:

deactivating at least one of an airbag and a seat heater of a corresponding seat when the corresponding seat is one of empty and occupied by a child seat.

42. (New) The method according to claim 26, further comprising:

capturing lip movements of a person in the vehicle to support a speech input system.

43. (New) The method according to claim 42, wherein:
the person is a driver of the vehicle.

44. (New) A device for monitoring an interior of a motor vehicle and a surrounding area of the motor vehicle, comprising:

a camera device configured to alternately capture an image of at least part of the interior of the motor vehicle and an image of at least part of the surrounding area of the motor vehicle; and

a processing unit connected to the camera device, the images captured by the camera device transmitted to the processing unit.

45. (New) The device according to claim 44, wherein:

a first beam path of the camera device points in a direction of a road in front of the vehicle; and

a second beam path of the camera device points in a direction of the interior.

46. (New) The device according to claim 45, wherein:

the second beam path of the camera device points in a direction of a driver in the interior.

47. (New) The device according to claim 44, further comprising:

an illumination unit configured to emit a radiation at least substantially invisible to the human eye, the illumination unit controlled by the processing unit.

48. (New) The device according to claim 47, wherein:

the radiation is infra-red radiation.

49. (New) The device according to claim 44, further comprising:

an infra-red filter arranged in the camera device.

50. (New) The device according to claim 49, wherein:

the infra-red filter is arranged in the second beam path in the direction of the interior.

51. (New) The device according to claim 44, further comprising:

at least one light valve arranged in the camera device.

52. (New) The device according to claim 51, wherein:

the at least one light valve is a liquid crystal cell.

53. (New) The device according to claim 44, further comprising:

at least one deviation mirror arranged in the camera device.

54. (New) The device according to claim 53, wherein:

the at least one deviation mirror is semi-transparent.

55. (New) The device according to claim 54, wherein:

the at least one deviation mirror is one of concave and convex.

56. (New) The device according to claim 44, wherein:

the camera device has a single camera.

57. (New) The device according to claim 56, wherein:

the single camera is one of a CCD camera and a CMOS camera.

58. (New) The device according to claim 44, wherein:

the camera device has at least two cameras for capturing images stereoscopically.

59. (New) The device according to claim 44, further comprising:

at least one of visual output units and acoustic output units connected to the processing unit, the at

least one of visual output units and acoustic output units configured to issue a warning to a driver when one of eyes of the driver are closed and the vehicle is about to move beyond a marked area of a road.

60. (New) The device according to claim 44, wherein:

the camera device is one of arranged in an upper part of a windshield and integrated into a roof of the vehicle.

61. (New) The device according to claim 53, further comprising:

an adjustment device configured to adjust the at least one deviation mirror so that at least eyes and lips of a driver can be seen in the image of the interior of the vehicle captured by the camera device.

Remarks

This Preliminary Amendment cancels, without prejudice, claims 1-25 in the underlying PCT Application No. PCT/DE00/01426 and adds new claims 26-61. The new claims conform the claims to U.S. Patent and Trademark Office rules and do not add new matter to the application.

The above amendments to the title, drawings, specification and abstract conform the title, drawings, specification and abstract to U.S. Patent and Trademark Office rules, and do not introduce new matter into the application.

The underlying PCT Application No. PCT/DE00/01426 includes an International Search Report, dated September 21, 2000. The Search Report includes a list of documents that were uncovered in the underlying PCT Application. A copy of the Search Report is included herewith.

It is respectfully submitted that the subject matter of the present application is new, non-obvious, and useful.

Prompt consideration and allowance of the application are respectfully requested.

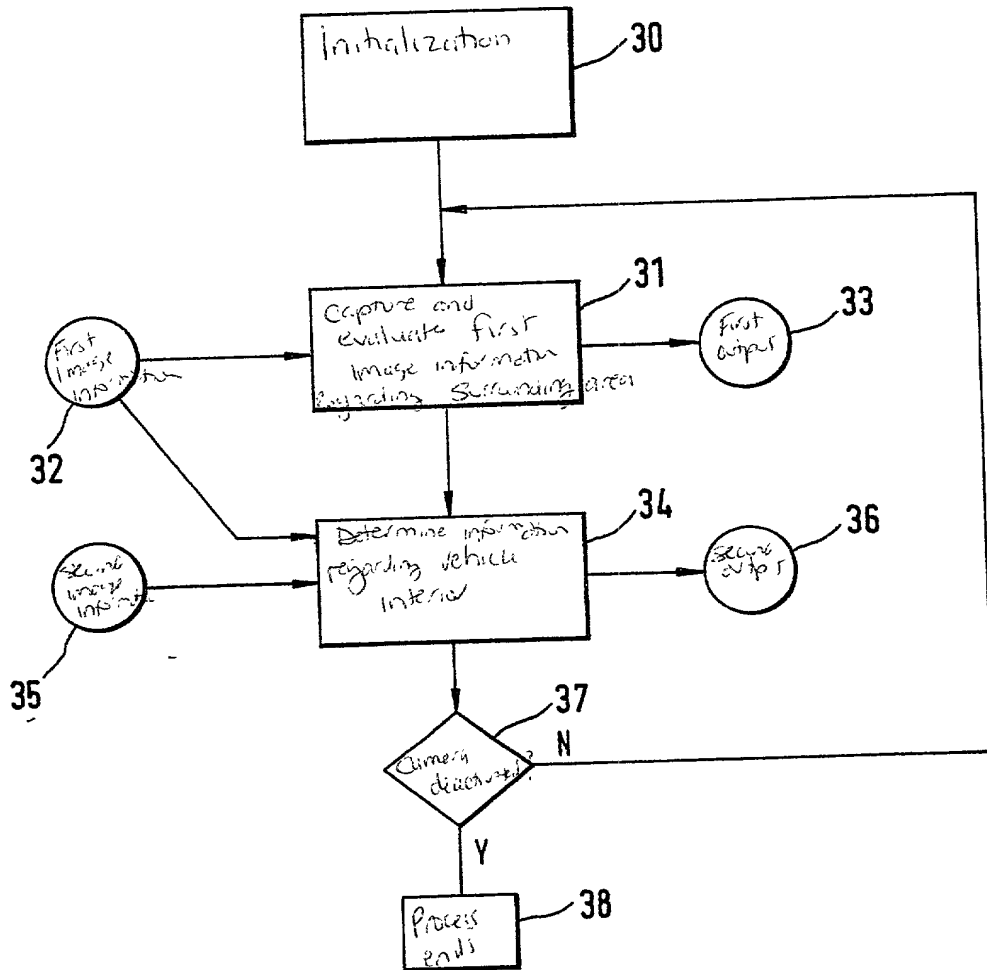
Respectfully submitted,

Dated: 1/8/01

By: *Richard L. Mayer*
Richard L. Mayer
Reg. No. 22,490

KENYON & KENYON
One Broadway
New York, NY 10004
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Fig.2



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Fig.2a

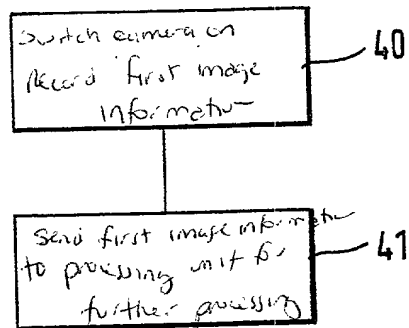
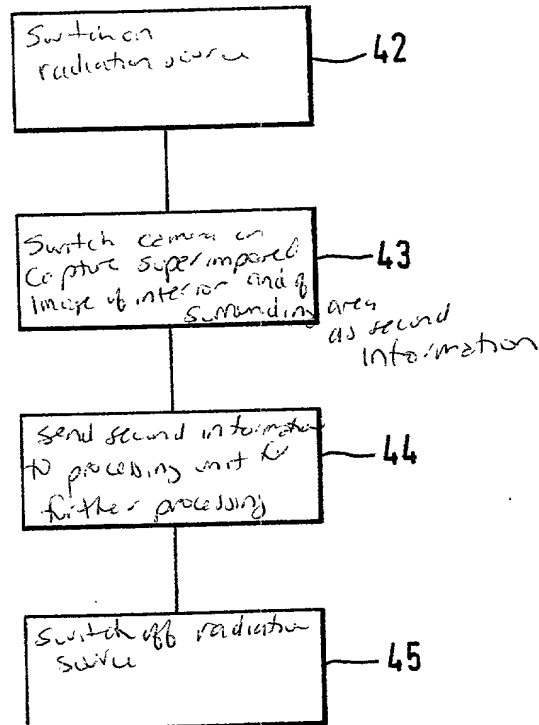
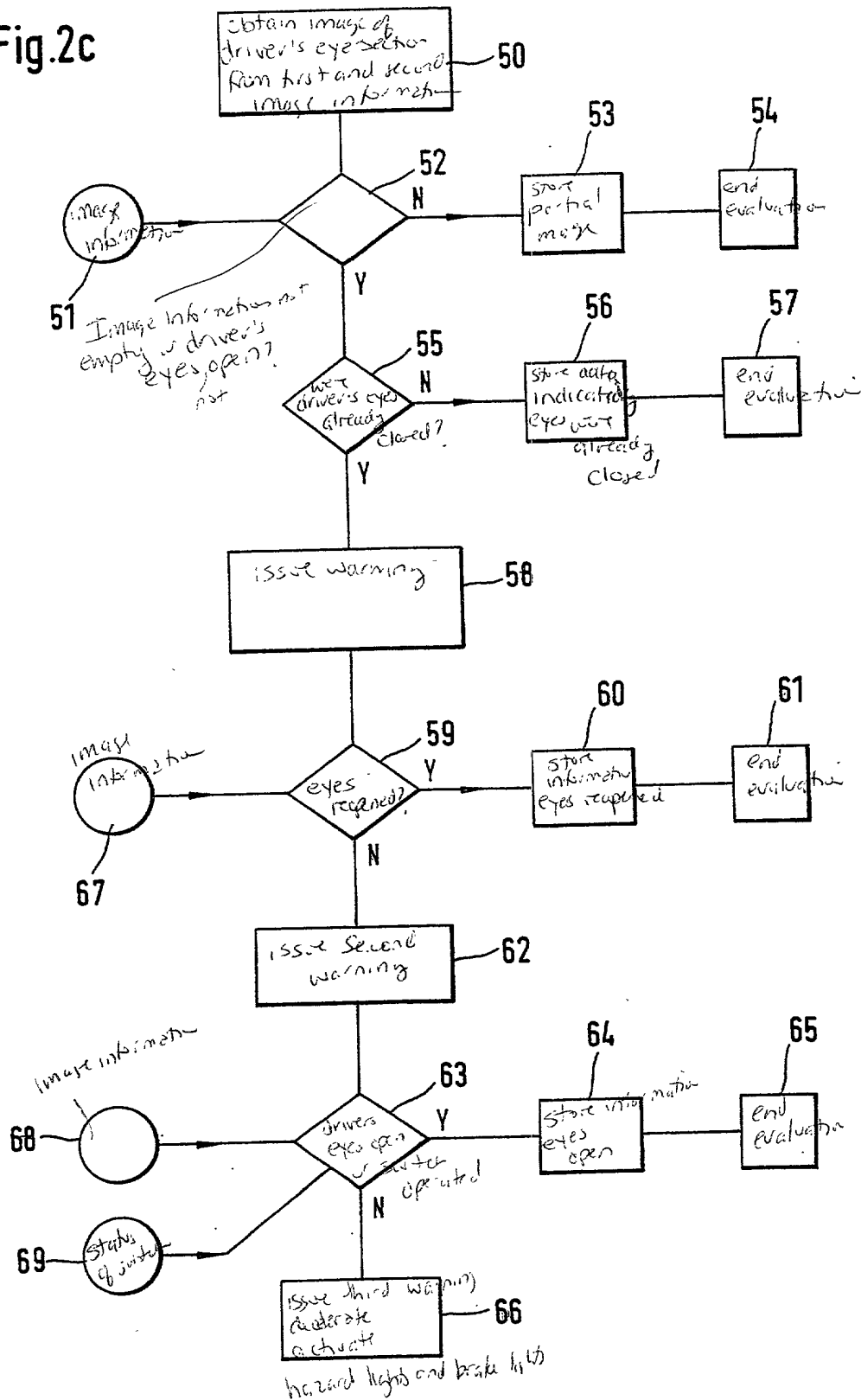


Fig.2b



4/10

Fig. 2c



5/10

Fig.3

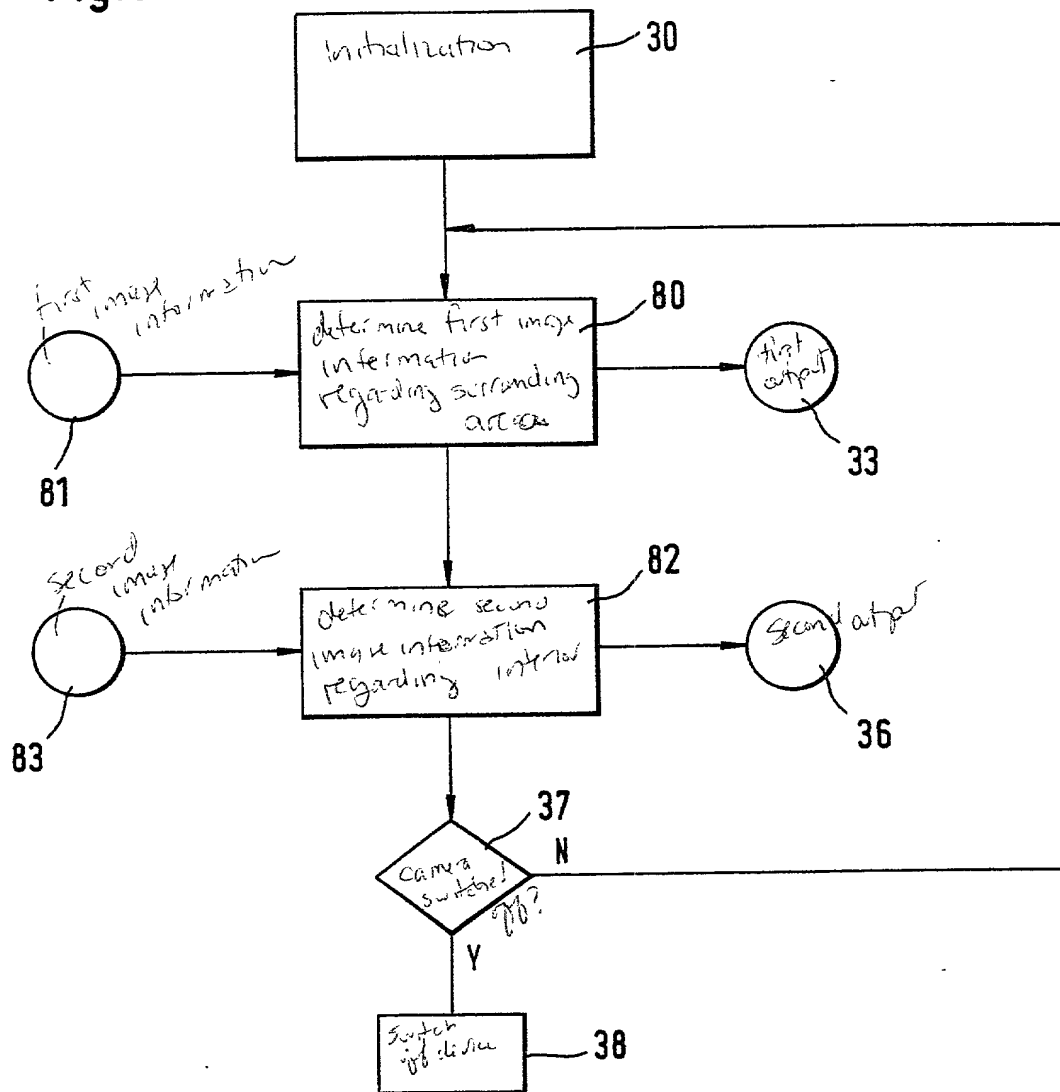


Fig. 4

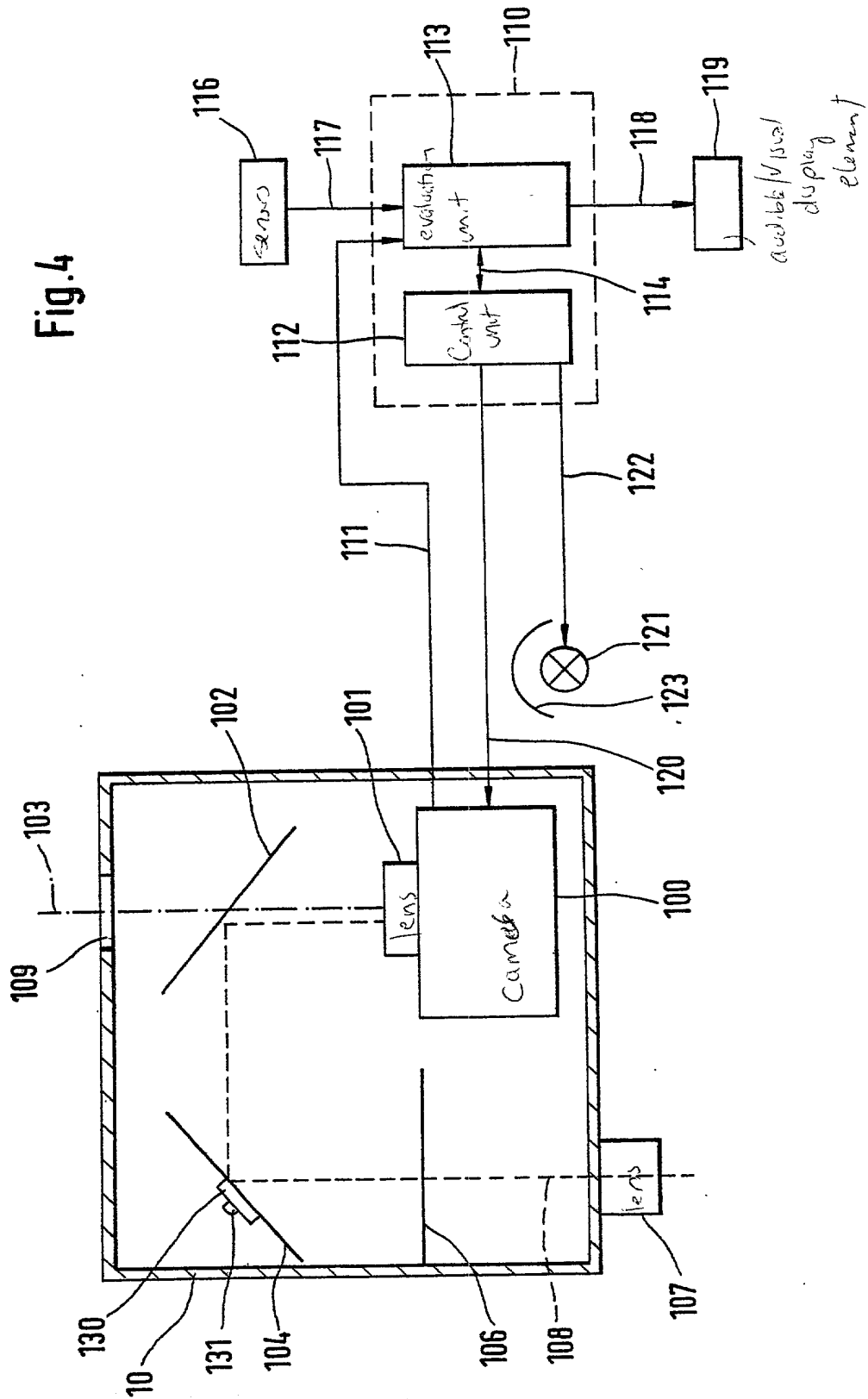


Fig. 5

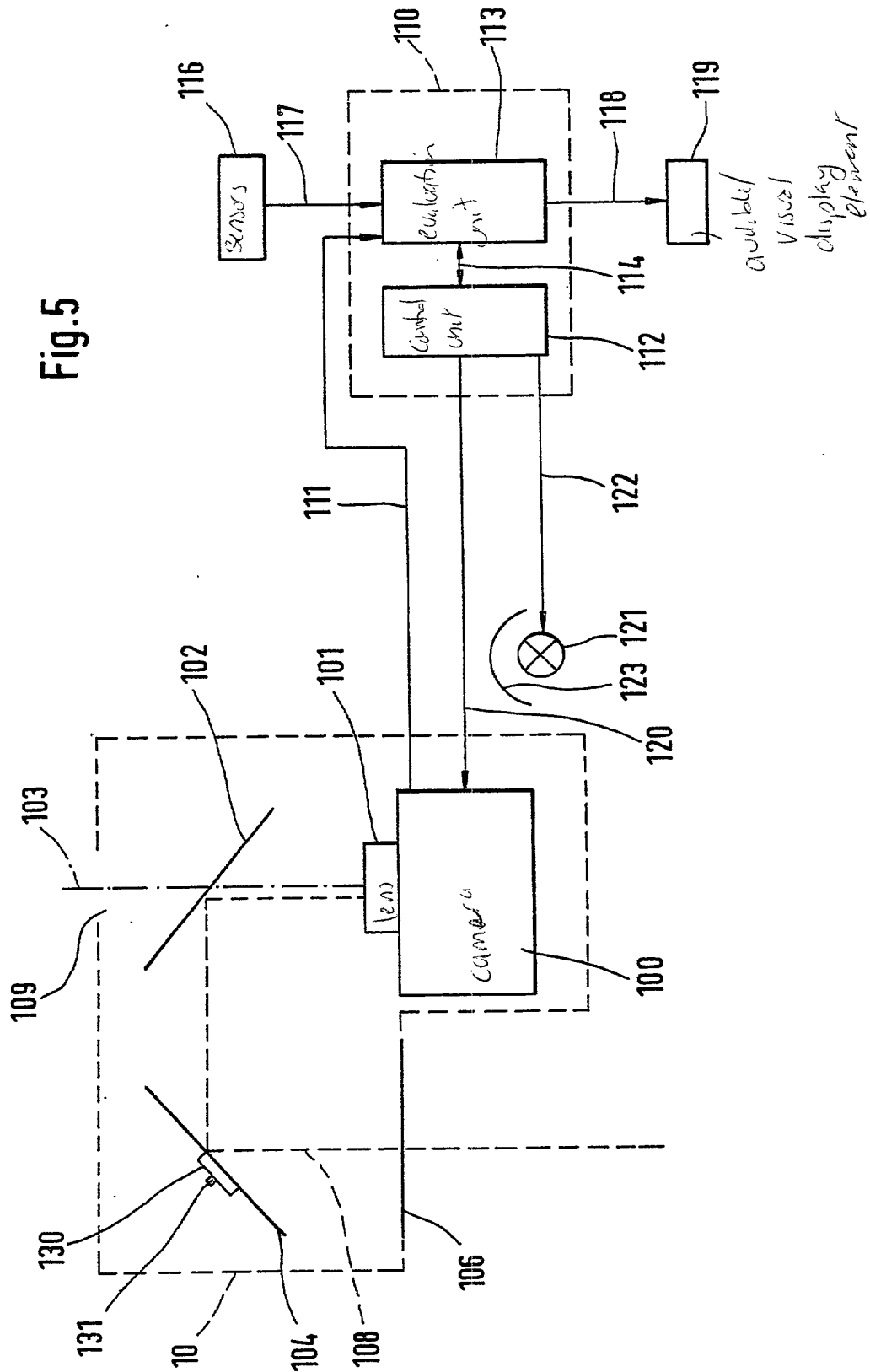
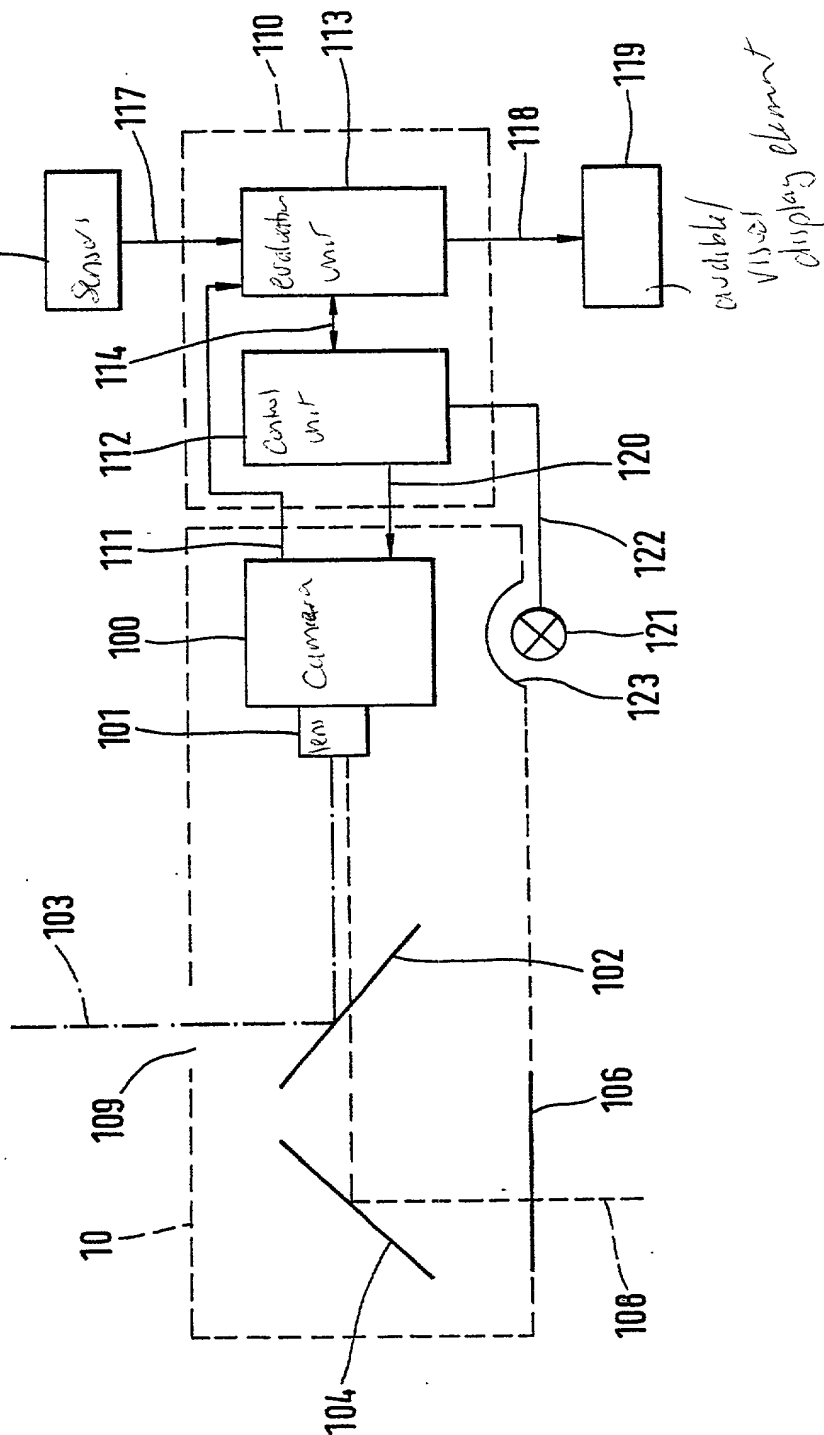
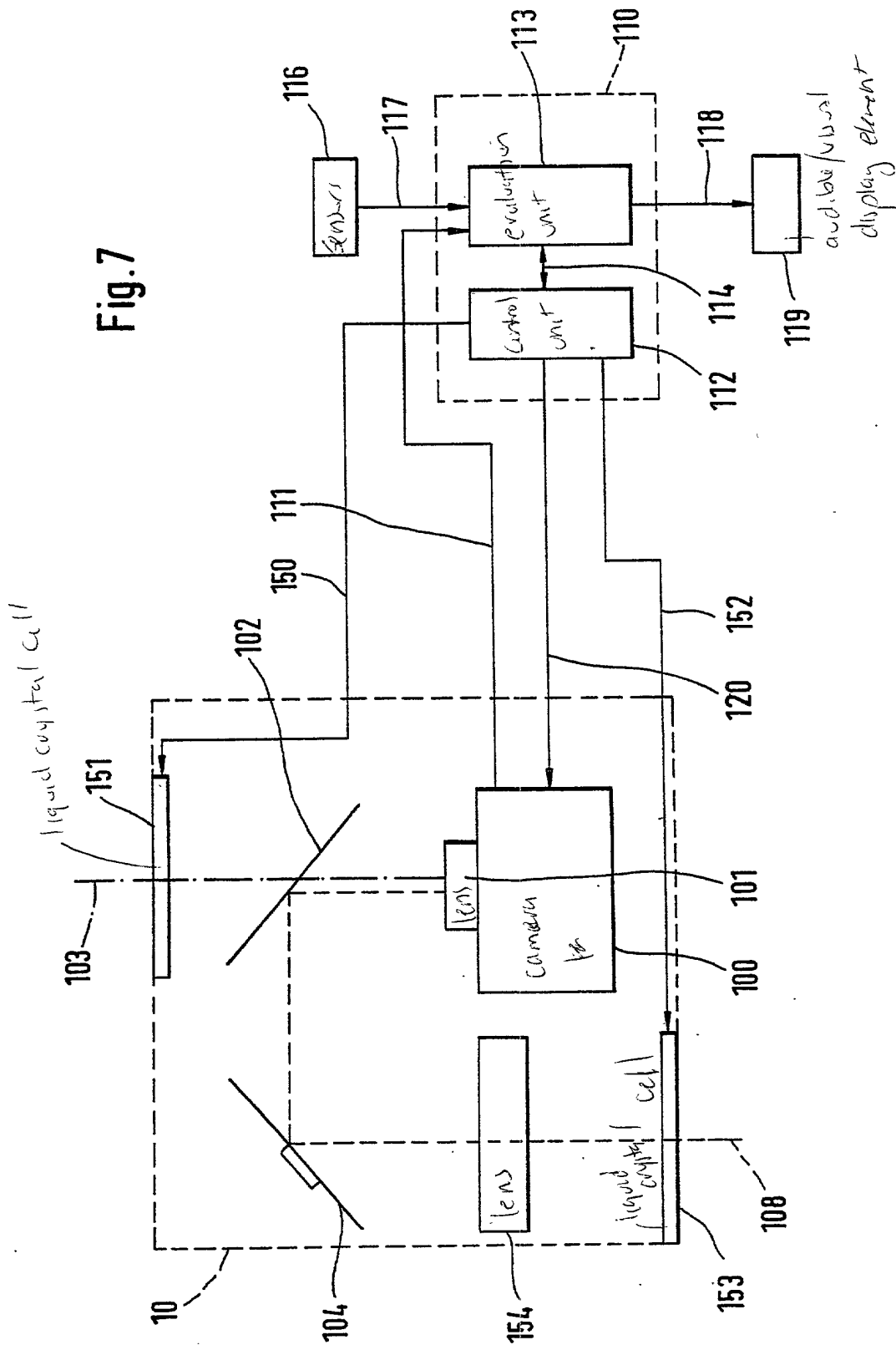


Fig. 6





METHOD AND DEVICE FOR MONITORING THE INTERIOR AND SURROUNDING
AREA OF A VEHICLE

Background of the Invention

The invention is based on a method according to the definition of the species set forth in the main claim. The article "Die neuen Augen des Autos, Limousinen lernen lesen [Cars Get New Eyes, Limos Learn to Read]" in the journal *Bosch Zünder*, October 1998 issue, page 8, describes a method in which the area in front of the driver surrounding the vehicle is monitored by two video cameras. The image captured by the cameras is then evaluated with regard to road signs that can be detected in the image, which are then displayed to the driver via a display unit. In addition, the system captures the path of the road in order to control the direction of the headlamps so that the light cone falls on the road. If the car enters the shoulder, an audible and/or visual warning is triggered. Furthermore, a method which measures brain activity, in particular of the driver of a vehicle, and which triggers an alarm if there are deviations from the normal awake status, is known from WO 93/21615. Herein, measurements are taken via electrodes placed on the driver's head.

Advantages of the Invention

By contrast, the method according to the present invention having the features set forth in the main claim has the advantage that the interior of as well as the area surrounding a vehicle can be captured using just one camera device. In particular, this is feasible because the interior of the vehicle and the area surrounding the vehicle are captured alternately. Provided the system alternates sufficiently quickly between capturing the interior and capturing the surrounding area, loss of information arising from switching back and forth may be ignored, and just one camera device as opposed to two is required for the interior and the area

surrounding the vehicle. Furthermore, only one processing unit for processing the image information obtained is required.

Moreover, it is particularly advantageous that the interior of the vehicle is illuminated by a radiation source that is at least largely invisible to the human eye. This has the advantage that during night driving, when as a general rule the interior of a vehicle is not lit or only poorly lit, the interior can nevertheless be monitored by a camera which is sensitive to radiation emitted by the radiation source. Herein it is particularly advantageous to use an infra-red radiation source, preferably one or more infra-red light-emitting diodes. This does not distract the driver, unlike a visible source.

Furthermore, it is advantageous to obtain an image of the interior from a superimposition of an image of the surrounding area and of the interior; a processing unit subtracts an image of the exterior only from this superimposition. As a result, when the system alternates between capturing the surrounding area and the interior, there is no need to interrupt recording of the exterior, because the system simply interrupts recording of the interior. As a result, there is no need for optical interrupt elements, such as in particular mechanical shutters or mirrors. In particular, if the interior is illuminated by an infra-red radiation source and the image of the interior is captured via an infra-red filter, an image of the interior is essentially only captured if the infra-red radiation source is activated. Thus alternating monitoring of the interior and the surrounding area is feasible via a switch-off/switch-on sequence for the infra-red radiation source provided the camera device has a further beam path which extends into the area surrounding the vehicle and can capture the area surrounding the vehicle.

Furthermore, it is advantageous to capture only the visible part of the surrounding area in a first process step, and to

capture only the visible part of the interior in a second process step. Thus it is not necessary for the images of the interior and the surrounding area to be separated in processing terms, which means the processing unit in which the image data is evaluated does not have to be especially powerful. Herein, it is particularly advantageous to carry out the switching over between capturing the part of the surrounding area visible to the camera and capturing the part of the interior visible to the camera via an electro-optical light valve, in particular via a liquid crystal cell, which can be switched back and forth between a transparent mode and an absorptive mode based on a signal applied.

Furthermore, it is advantageous when switching back and forth between capturing image signals from the surrounding area and image signals from the interior to switch back and forth as soon as partial areas of the maximum area that can be captured by the camera device have been captured. In particular, switching back and forth may be carried out after image columns or image rows have been captured or after groups of pixels have been captured. As the image data also has to be transmitted to the processing unit and processed there, this method has the advantage that it allows quicker switching back and forth between capturing the interior and the exterior, so that the shift between two captured images, e.g., of the exterior, which is based on the movement of the vehicle, is reduced.

Furthermore, it is advantageous to capture the driver's face, in particular his eyes, as well as the road markings and, respectively, the position of the vehicle relative to the road markings; this is because this information can be used to determine whether the driver may have fallen asleep and may therefore be driving in an uncontrolled manner, and can be used to activate a warning device which wakes up the driver. Thus, because the driver's face is also captured, additional safety compared to the related art, in which a camera device

only captures the road markings, is achieved. For example, when the vehicle is traveling in a straight line for a long period, the vehicle may travel for some considerable time within the road markings, even though the driver has already
5 been asleep for a number of seconds. Using the method according to the present invention, it is possible to detect that the driver has fallen asleep in a case of this kind.

If the camera is used for monitoring, it is not necessary to
10 place electrodes on the driver's body, which is necessary in the case of the method in which the driver's brain waves are monitored. Because electrodes of this kind may be cumbersome and may limit the driver's freedom of movement, and because the driver may also forget to put them on when he starts
15 driving or may deliberately not put them on because they are uncomfortable, a warning indicating that the driver has fallen asleep is easier to implement and less unpleasant for the driver to use. Furthermore, the method according to the present invention has the advantage that as well as monitoring
20 the interior, the system can capture road signs in the area surrounding the vehicle and can therefore alert the driver, for example, to warning signs or speed limit signs via a visual or acoustic output unit.

25 Furthermore, it is advantageous to determine the number of people in the vehicle or, respectively, the seat occupancy. This information can be used, for example, to control the chassis so as to compensate for uneven load in the vehicle if, for example, people are only sitting on the left side of the
30 vehicle, namely the driver and one person behind him. Furthermore, this information can be use to control a seat heater which is only activated if someone is actually using on the seat. In particular, it is possible to determine whether a seat is occupied or is occupied by a child seat, as it is
35 advantageous that deployment of an airbag can be blocked if a seat is unoccupied or is occupied by a child seat. As a result, unnecessary deployments of an airbag can be avoided if

the seat is unoccupied, and injury to a child by an airbag can be prevented if the seat is occupied by a child seat.

Furthermore, it is advantageous to also capture the lip movements of a predefinable person in the vehicle, preferably the driver, in order to support a speech input system. If, for example, during speech input it is unclear which command has been input due to driving noise, the driver's lip movements can be captured by the camera device and evaluated so as to check the speech input. This is possible, for example, if the lip movements are analyzed to determine whether the syllables that correspond to the lip movements captured are contained in the command understood by the speech input unit. If the speech input unit cannot make unambiguous assignments based on what it has understood, this can possibly be achieved by carrying out a comparison with the lip movements.

Furthermore, it is advantageous to provide a device so as to allow capturing of the area surrounding the vehicle and of the vehicle interior. In particular, it is advantageous to design a camera device so that one beam path points in the direction of the interior and one beam path points in the direction of the road, preferably in the direction of travel, because as a general rule from the driver's point of view the road, i.e., the edge of the road, and objects in his own lane are the most important information in the area surrounding the vehicle.

Furthermore, it is advantageous to provide a deviation mirror that is semi-transparent in the camera device. One beam path, e.g., from the interior, may enter the camera device via reflection, and another beam path may enter via transmission through the semi-transparent mirror. As a result, there is no need for mechanical adjusting between the two beam paths.

Furthermore, it is advantageous to design at least one deviation mirror to be concave or convex; as a result, the area that can be monitored by the camera can be limited or enlarged, depending on the use of the device.

Furthermore, it is advantageous to design the camera as a CCD camera or a CMOS camera. As a result, the camera device according to the present invention can be designed particularly inexpensively. Furthermore, it is advantageous to equip the camera device with at least two cameras, so that stereoscopic image capturing is possible, and so that conclusions can be drawn regarding the distances between the vehicle and objects and distances in the interior, respectively, by evaluating distance-dependent image shift.

In addition, it is advantageous to arrange the camera device in an upper part of the windshield or to integrate the camera device into the roof of the vehicle. A position at least close to the vehicle roof allows an especially good overview of the area surrounding the vehicle and of the vehicle's interior.

Furthermore it is advantageous to design at least one deviation mirror so that it can be adjusted by an adjustment device so that at least the eyes and/or lips of the driver can be captured by the camera. This is particularly useful if drivers alternate and are of different heights and may arrange the seat in different positions. Furthermore, it enables the driver's movements while driving to be taken into account. By designing the deviation mirror so that the visible range captured can be readjusted, it is possible to ensure that the driver's eyes and/or lips are always within the capturing area of the camera device. This ensures that the means for monitoring whether the driver has fallen asleep and the means for checking speech input function properly, especially during driving.

Drawings

Exemplary embodiments of the present invention are shown in the drawings and are described in greater detail below. Figure 1 shows an arrangement of the device according to the present invention in a motor vehicle; Figure 2 shows a flow chart of the method according to the present invention; Figures 2a and

2b show details of the method according to the present invention; Figure 2c shows an evaluation method according to the present invention; Figure 3 shows a flow chart for a further embodiment of the method according to the present invention; Figure 4 shows an embodiment of the device according to the present invention; Figure 5 shows another embodiment of the device according to the present invention; Figure 6 shows another embodiment of the device according to the present invention; Figure 7 shows a further embodiment of the device according to the present invention; and Figures 8a and 8b show embodiments of a deviation mirror according to the present invention.

Description of the Exemplary Embodiments

In Figure 1, a camera device 10 according to the present invention is arranged in a motor vehicle on upper edge 11 of a windshield 12. The camera device has a first optical opening 13, a first beam path 14 leading to a driver 15 of the vehicle. The mid-point beam of the beam path is shown. In addition, camera device 10 has a second optical opening 16, which is arranged on the opposite side of camera device 10 to first optical opening 13 and is therefore not visible in the view shown in the drawing. Second optical opening 16 is therefore only shown using a broken line. In addition, a second beam path 17, which leads from second optical opening 16 of camera device 10 through windshield 12 into the area surrounding the vehicle in front to the vehicle, is shown. The driver's line of sight, which is shown as a third beam path 18, extends in the same direction. Furthermore, cockpit 19 of the vehicle has a steering wheel 20 and a display unit 21. Herein, display unit 21 is preferably embodied as a combination instrument in which a plurality of displays are integrated into one electronic unit. In particular, a freely programmable combination instrument, in which various display instruments are shown on a screen, e.g., in the form of a liquid crystal display, is feasible. The figure also includes a processing unit which processes the image information

recorded by camera device 10, but this is not shown separately. The processing unit may either be arranged in the housing of camera device 10 shown, or in the vehicle roof on the other side of upper edge 11 of the windshield, or in cockpit 19 of the vehicle. In a preferred exemplary embodiment, the processing unit is arranged in a part of display unit 21 that is not visible to driver 15. As display unit 21 is used to output visual warning signals that are based on the evaluation by the processing unit of the image information recorded by camera device 10, e.g., if the driver is about to fall asleep or has exceeded the maximum speed limit, long data transmission paths can be avoided.

Camera device 10 is arranged in the upper part of windshield 12 close enough to the vehicle roof (not shown) so that the vehicle interior and the road in front of the vehicle can be monitored effectively. Preferably the camera device therefore is arranged in the middle of the vehicle with respect to the sides of the vehicle. It is also feasible for it to be arranged in the left upper part of windshield 12 in a left-hand-drive vehicle, as this ensures that not only the driver but also the entire road can be effectively captured by the camera device. In a right-hand-drive car, the camera is arranged in a right upper section of windshield 12. First and second optical openings 13, 16 may be designed in various ways. Any of the following ways are feasible: A filter, an opening, a lens, or a combination thereof in which the aforementioned components are arranged behind one another.

Figure 2 shows a flow chart for the method according to the present invention. Starting from an initialization step 30, in a first process step 31 first image information 32 of the surrounding area is captured and evaluated by the processing unit, a first output 33 being output via visual and/or acoustic output media based on first image information 32. Thus the first output is based on the area surrounding the vehicle. In a subsequent second process step 34, image

information regarding the vehicle interior is determined from second image information 35, in which superimposed image information regarding the surrounding area and the vehicle interior is captured, based on first image information 32 regarding the surrounding area obtained previously, by subtracting first image information 32 from second image information 35, so that based on the image information obtained a second output 36 is also output via visual and/or acoustic output media, the second output being in particular dependent on the image information regarding the vehicle interior. In a subsequent decision step 37, the process is aborted if the camera device is deactivated, i.e., in particular if the vehicle is turned off. This decision path is shown as Y in the drawing. In this case, the process ends when the camera device is switched off in a subsequent process step 38. If the vehicle is not turned off, processing branches back to first process step 31. This decision path is shown as N in Figure 2.

In Figure 2a, first process step 31 is shown in detail. In a first sub-step 40, the camera device is switched on and first image information 32 is recorded. In a second sub-step 41, first image information 32 is sent to the processing unit for further processing.

In Figure 2b, second process step 34 is subdivided into sub-steps. In a first sub-step 42, the radiation source that is not visible to the human eye is switched on by being supplied with electrical voltage. In a second sub-step 43, camera device 10 is switched on and a superimposed image of the interior and of the surrounding area is captured as second image information 35. In addition, a lighting adjustment must be carried out based on the lighting conditions, e.g., via an adjustable diaphragm opening or adjustment of the current applied to the light-sensitive sensors of the camera device. In a third sub-step 44, after the image has successfully been recorded, second image information 35 is stored and sent to

the processing unit for further processing. In a fourth sub-
step 45, the radiation source that is not visible to the human
eye is switched off. The image of the interior is then
determined in a processing step (not shown in Figure 2b) in
the processing unit.

Figure 2c shows an evaluation process carried out by the
processing unit which includes processing of the image
information recorded by the camera device and of first output
33 and second output 36, respectively. An example of an
evaluation process is a falling-asleep warning generated by
monitoring driver 15, monitoring of the vehicle's interior
being necessary and second output 36 consequently being
output. A method for detecting the surrounding area, e.g., for
detecting road signs and/or road markings, can be embodied in
a similar manner, first output 33 being output.

In a first initialization step 50, the processing unit obtains
an image of the driver's eye section from first and second
image information 32 and 35. In a first decision step 52, the
recorded image is compared with image information 51 regarding
the driver's eye section that has been stored previously.
Herein, image information 51 is an empty image if the vehicle
has just been started up and as yet no image information has
been stored. If it is determined that the driver's eyes are
open, i.e., the driver is not asleep, or if image information
51 is an empty image, processing branches along decision path
N, and in process step 53 the recorded partial image is
stored. Furthermore, the fact that the driver is awake at the
time the image was recorded is stored in another memory. The
evaluation process is ended in a completion step 54. The
evaluation process is started again the next time first and
second image information 32 and 35, respectively, are
transmitted to the processing unit. A new start is carried out
each time the evaluation process ends provided the vehicle or
the camera device have not been switched off.

If the processing unit determines that the driver's eyes are closed, processing branches from first decision step 52 to a second decision step 55 along decision path Y. Here, a check is performed to determine whether the driver's eyes were
5 already closed the last time an image was recorded. If not, processing branches to a sub-step 56, where data is stored indicating that the driver's eyes are closed at the point in time the image was recorded. In a completion step 57, the evaluation process is ended. If the driver's eyes were already
10 closed the last time an image was recorded, processing branches along decision path Y from second decision step 55 to a first warning step 58. This warning is an audible warning and/or a visual warning, preferably via display unit 21. Because a warning is not issued until a second image has been
15 recorded and thus after second decision step 55, it is generally possible to avoid a situation where a warning is issued because, by chance, the image was taken exactly at the moment the driver blinked, thus causing camera device 10 to detect that the driver's eyes are closed.

20 After first warning step 58, a third decision step 59, in which image information 67 regarding a further image of the driver's face section is taken into account, is carried out. If the driver's eyes have reopened, processing branches along
25 decision path Y to a processing step 60, image information 67 that has been newly recorded being stored. Furthermore, data indicating that the driver's eyes are open is stored in a memory. The evaluation process is ended in a subsequent completion step 61. However, if the driver's eyes are still
30 closed, processing branches from third decision step 59 along decision path N to a second warning step 62. In second warning step 62, a significantly louder audible warning is issued than that issued in first warning step 58. In a fourth decision step 63, image information 68 regarding the driver's facial
35 section is captured again and status 69 of a switch is queried. If it is determined that the driver's eyes are now open or if the driver operates the switch, processing branches

along decision path Y. In a first sub-step 64, data indicating that the driver's eyes are open is stored and the evaluation process is ended in a completion step 65. If it is not determined that the driver's eyes are open or if it is not determined that the switch has been triggered, processing branches along decision path N to a third warning step 66. A loud audible warning is now issued again, and the vehicle is decelerated, the hazard warning lights system and the brake lights being activated so that driverless driving is avoided. As there are circumstances in which the camera device cannot obtain an image of the driver's eyes, e.g., if he is wearing sunglasses, the process shown in Figure 2c can be deactivated.

Furthermore, it is possible to increase the number of times the image information regarding the driver's eye section is queried before an appropriate warning step is carried out, so as to avoid incorrect issuing of warnings. Herein, the number of queries is based on how frequently image information regarding the interior is captured. The process shown in Figure 2c may also be used to monitor the vehicle's position relative to a road marking if, instead of capturing image information regarding the driver's facial section, image information regarding the road marking is captured and the vehicle's position relative to the road marking is evaluated.

Figure 3 shows a further method according to the present invention for monitoring the area surrounding the vehicle the vehicle interior. The same reference numbers represent the same process elements as those in Figure 2. Following an initialization step 30, in a first process step 80 first image information 81 regarding the vehicle's surrounding area is determined, sent to the processing unit, and first output 33 is output based on first image information 81. In second process step 82, second image information 83 regarding the interior is captured by the camera device and sent to the processing unit. Second output 36 is output based on the image information captured. During first process step 80, an

electro-optical light valve in the direction of the vehicle's surrounding area is opened. In second process step 82, an electronic light valve in the direction of the vehicle's interior is opened. After second process step 82, a decision step 37 is carried out. If the camera device is switched off, processing branches along decision path Y and the camera device is switched off in a subsequent process step 38. Otherwise, processing branches back to first process step 80 via decision path N. Herein, in a preferred exemplary embodiment, in first and second process steps 80, 82 the light valve in question is only opened for 90% of the duration of the process step in question. This ensures that the two sets of image information to be recorded do not overlap. Particularly at low temperatures, this keeps the image information to be recorded from overlapping, as low temperatures may cause the liquid crystal's switching behavior to become sluggish. The evaluation process described in Figure 2c can be applied directly to the first output and/or second output 36 in Figure 3.

Figure 4 shows an embodiment according to the present invention of a camera device 10 having a processing unit 110. Camera device 10 is arranged in a housing in which a camera 100, which is designed as a CCD camera or a CMOS camera, is arranged with a first lens 101. Light from a first deviation mirror 102 enters first lens 101. First deviation mirror 102 is semi-transparent, so that a first beam path 103 from the vehicle's surrounding area passes through an opening 109 in the housing of camera device 10, then passes through first deviation mirror 102 and then through first lens 101 to camera 100. Furthermore, a second beam path 108 from a second deviation mirror 104 travels to first deviation mirror 102. Second beam path 108 is deviated by first deviation mirror 102 and travels to camera 100. Second beam path 108 travels from the vehicle interior and enters camera device 10 through a second lens 107. Before it reaches second deviation mirror 104, it passes through an infra-red filter 106. Camera 100 is

connected to processing unit 110 via a first data circuit 111. Processing unit 110 includes a control unit 112 and an evaluation unit 113, which are connected to one another via a second data circuit 114. Evaluation unit 113 is connected via a third data circuit 117 to sensors 116 and via a fourth data circuit 118 at least to audible and/or visual display elements 119. Furthermore, control unit 112 is connected via a fifth data circuit 120 to camera 100 and via a sixth data circuit 122 to a radiation source 121, which emits radiation that is invisible to the human eye. Radiation source 121 is arranged in a housing which is preferably designed as a reflector 123.

First beam path 103 and second beam path 108 are denoted by the optical axis of the beam in question. Here and in Figures 5-7, only the midpoint beam, which represents the entire beam path, is shown. In front of lens 101, the optical axis of the two beam paths coincides. However, for the purposes of clarity, in Figure 4 and the subsequent figures we have shown the two beam paths in parallel.

Processing unit 110 and camera device 10 may also be arranged in a single housing near the vehicle roof i.e., near the upper edge of windshield 12. However, processing unit 110 and camera device 10 may also be arranged in different places within the vehicle. In a preferred exemplary embodiment, processing unit 110 is integrated into display unit 21.

In first process step 31 in Figure 2, an image of the vehicle's surrounding area is captured by camera 100 with the help of first beam path 103. Herein, the image captured depends on how camera device 10 is arranged in the vehicle, and also on the size of opening 109 in the housing of camera device 10, and also on the setting of first lens 101. Herein, opening 109 preferably has a transparent cover, e.g., a transparent plastic disk. Furthermore, a third lens may be arranged there. When second process step 34 is carried out, in first sub-step 42 radiation source 121 is switched on by

control unit 112 via sixth data circuit 122 for the duration of the time period during which the image is captured, this being accomplished by applying a voltage to radiation source 121. Figure 4 does not show the voltage source. The beam, which is bundled by reflector 123, is radiated into the vehicle's interior. The beam that is radiated is invisible to the human eye. Preferably the radiation source is designed as an infra-red beam diode or an infra-red beam diode array that includes a plurality of infra-red beam diodes. If the interior of the vehicle is illuminated by radiation source 121, the infra-red radiation that is reflected in the vehicle's interior passes through second lens 107 along second beam path 108 into camera device 10 and reaches infra-red filter 106. This filter only allows through infra-red radiation, so that visible light from the vehicle interior does not reach camera 100. Thus in particular it is possible for the vehicle interior to be captured independently of visible light. Illumination of the interior is thus only dependent on the intensity of radiation source 121. Thereafter, the filtered infra-red radiation passes to second deviation mirror 104, then to first deviation mirror 102, then to first lens 101 and into camera 100. Second deviation mirror 104 has an adjustment device 30. In the figure only a mounting 130 of this adjustment device is shown. An electric motor, a control unit and a power supply are not shown. With the help of this adjustment device, second deviation mirror 104 can be rotated about an axis of rotation 131 within a certain angular range. As a result, the area of the interior which is imaged by second lens 107 and via the second deviation mirror into camera 100 can be modified. This is particularly useful if a driver changes the position of his seat while driving and camera device 10 must continue to capture his facial section.

Sensors 116 may be designed as, for example, seat sensors, which supply information as to whether a seat is occupied. If a seat sensor reports that a seat is unoccupied, the camera can check whether this is true or whether there is movement,

for example, on the seat indicating that the seat is in fact occupied. In such cases, an airbag is not deactivated and/or seat heating is not deactivated. Furthermore, sensors also mean input elements via which, for example, a falling-asleep warning can be deactivated if the driver is wearing sunglasses which mean that his eyes cannot be seen camera 100. Output units mean audible and/or visual warning elements that may be embodied as a loudspeaker, a warning light or a liquid crystal display. Evaluation unit 113 and control unit 112 may also be integrated in a device. Furthermore, control unit 112 controls the position of second deviation mirror 104 via a connection line (not shown), based on instructions transmitted from evaluation unit 113 via second data circuit 114. If an object being monitored by camera device 10 threatens to move beyond the visible range, the processing unit can in this way modify the visible range via the control means of the second deviation mirror. First data circuit 111 and fifth data circuit 120 constitute a connection between camera device 10 and processing unit 110. Herein, first data circuit 111 is used to transmit image information from camera 100 to processing unit 110, in particular to evaluation unit 113. Processing unit 110, in particular control unit 112, controls camera 100 via fifth data circuit 120. First data circuit 111 and fifth data circuit 120 may also be combined as a single data circuit.

Figure 5 shows a further exemplary embodiment according to the present invention of the device for monitoring a vehicle's surrounding area and the vehicle interior. Here and in the subsequent figures, once again the same reference numbers denote the same components. In Figure 5, second beam path 108 leaves the housing of camera 10 after passing through infra-red filter 106. In Figure 5, in order to distinguish the housing of camera device 10 from infra-red filter 106, we have shown the former using a broken line. The embodiment shown in Figure 5 allows the camera device to be arranged parallel to the sectional plane and perpendicular to the vehicle roof. In

a preferred exemplary embodiment, in which camera device 10 is arranged perpendicular to the vehicle roof, the area around the camera as far as opening 109 is completely housed in the vehicle roof, while the area around the second deviation mirror protrudes into the vehicle interior, i.e., the sectional plane in the drawing is perpendicular to the vehicle roof. Aside from adjustment of second deviation mirror 104, essentially the optical properties of first lens 101 are used to produce an image in camera 100.

In Figure 6, a further embodiment according to the present invention of the device for monitoring a vehicle's surrounding area the vehicle interior is shown. In this exemplary embodiment, camera 100 is arranged on a different side of first deviation mirror 102 from that in Figures 4 and 5. In this case, the light that follows first beam path 103 is reflected by first deviation mirror 102 onto camera 100. By contrast, the light that follows second beam path 108 is deviated by second deviation mirror 104, so that the beam passes through first deviation mirror 102, which is embodied as a semi-transparent mirror, and ultimately reaches camera 100. Furthermore, in this exemplary embodiment reflector 123 is integrated into the housing of camera device 10, thus saving space. However, radiation source 121 may also be arranged in a favorable position in the vehicle some distance away from camera device 10. In addition, a plurality of radiation sources may be provided in the vehicle to ensure the vehicle's interior is optimally illuminated.

Figure 7 shows a device for carrying out the method according to the present invention described in Figure 3. Instead of opening 109, an electro-optical light valve in the form of a first liquid crystal cell 151 is placed in first beam path 103. First liquid crystal cell 151 can be controlled by control unit 112 via a control line 150, so that it is possible to switch first liquid crystal cell 151 back and forth between a transmissive and an absorptive state. The

structure of the liquid crystal cell is not shown in detail in the drawing, nor is the power supply shown. Herein, first liquid crystal cell 151 may be embodied so that a liquid crystal between two glass substrates is arranged between two transparent electrodes and influences the polarizing direction of light in different ways based on an electrical field that is applied. By arranging polarizing films on the glass substrates, it is possible to establish a desired level of absorption of light based on the voltage applied to the transparent electrodes or, respectively, a predefined maximum transmission of light based on the glass substrate, the polarizers and the liquid crystal. Furthermore, a second liquid crystal cell 153 is provided, can be controlled by control unit 112 via a control line 152 and is arranged in second beam path 108. In first process step 31, first liquid crystal cell 151 is switched over to a transparent state and second liquid crystal cell 153 is switched over to an absorptive state. In this case, only the light from the vehicle's surrounding area enters camera 100 along first beam path 103. In second process step 34, first liquid crystal cell 151 is then switched over to its absorptive state and second liquid crystal cell 153 is switched over to its transmissive state. In this case, light passes along second beam path 108 through a third lens 154 and via second deviation mirror 104 and first deviation mirror 102 into camera 100. In order to avoid overlap, an intermediate step in which both liquid crystal cells 151 and 153 are switched over to their absorptive state may be inserted between the two process steps. This is recommended in particular at low temperatures, because in such cases switching over of the liquid crystal may be subject to a delay and maximum absorption and transmission, respectively, is not reached until the electrical field has been present for some time. By contrast with the exemplary embodiments shown in Figures 4 to 6, in the device shown in Figure 7 visible light also enters camera 100 along second beam path 108.

Furthermore, in the case of all the aforementioned exemplary
embodiments, two closely adjacent cameras whose first and
second beam paths are offset slightly relative to one another
may be provided instead of single camera 100. This allows
5 images to be captured stereoscopically. With the help of
suitable calculations performed by evaluation unit 113,
conclusions regarding the distances to individual objects can
be drawn from the captured stereoscopic images. This is
advantageous in the case of detection of objects, e.g., road
10 signs.

Figures 8a and 8b show exemplary embodiments of second
deviation mirror 104. In Figure 8a, a second deviation mirror
1041 is concave, and in Figure 8b a second deviation mirror
1042 is convex. It is feasible to use either deviation mirror
1041 or deviation mirror 1042 as a second deviation mirror
104. Because the mirror is embodied in this way, the area
visible to the camera can be modified. The mirror shown in
Figure 8b can be used to enlarge the beam area, whereas the
mirror shown in Figure 8a can be used to limit the beam area;
this is accomplished thanks to the differing curvature of the
respective mirrors.

Claims

1. A method for monitoring the interior of and area surrounding a vehicle, in particular a motor vehicle, characterized in that in a first method step, at least part of the area surrounding the vehicle, preferably in the direction of travel, and in a second method step, at least part of the vehicle's interior, preferably parts of the driver's body, are captured by a camera device (10), the first and second method steps are carried out alternately, and image information obtained in this way is sent to a processing unit (110) and processed there.

2. The method according to Claim 1, characterized in that in the second process step the interior of the vehicle is illuminated by a radiation source (121) that is at least largely invisible to the human eye, preferably an infra-red radiation source.

3. The method according to Claim 2, characterized in that in the second process step the part of the interior visible to the camera device (10) is superimposed on the part of the surrounding area visible to the camera device (10), and the image of the interior is determined by subtracting the image of the exterior obtained in the first process step.

4. The method according to Claim 1, characterized in that in the first process step only the part of the surrounding area visible to the camera device (10) is captured, and in the second process step only the part of the interior visible to the camera device (10) is captured.

5. The method according to Claim 4, characterized in that switching back and forth between capturing the interior and the surrounding area is

accomplished via at least one light valve, which is preferably an electro-optical light valve (151, 153).

6. The method according to one of the preceding claims, characterized in that an image that is captured constitutes in each case only a partial area of the maximum image that can be captured by the camera, in particular image rows, image columns or image pixels, and switching back and forth between capturing this partial area of the interior and of the surrounding area is carried out, and the partial areas captured are processed by the processing unit (110), and then the next partial area is captured.

7. The method according to one of the preceding claims, characterized in that the driver's face, in particular his eyes, are captured.

8. The method according to one of the preceding claims, characterized in that road markings and/or the position of the vehicle relative to the road markings are captured.

9. The method according to one of Claims 7 through 8, characterized in that the driver's face and/or the position of the vehicle relative to the road markings are evaluated to determine whether the driver's eyes are open and/or to determine whether the vehicle is moving beyond a predefined area of the markings, and a visual and/or audible warning is issued based on the evaluation.

10. The method according to one of the preceding claims, characterized in that road signs are captured.

11. The method according to one of the preceding claims, characterized in that the number of people in the vehicle and/or the seat occupancy is determined.

12. The method according to Claim 11,

characterized in that if a given seat is empty or occupied by a child seat deployment of the corresponding airbag and/or a seat heater is blocked.

13. The method according to one of the preceding claims, characterized in that the lip movements of a predefinable person in the vehicle, preferably the driver, are captured in order to support a speech input system.

14. A device for carrying out the method according to one of the preceding claims, characterized in that a vehicle, preferably a motor vehicle, has a camera device (10) and a processing unit (110, 112, 113), at least part of the interior of and at least part of the area surrounding a vehicle can be captured by the camera device (10), that the camera device (10) is connected to the processing unit (110, 112), and that the images captured can be transmitted to the processing unit (110, 113).

15. The device according to Claim 14, characterized in that a first beam path (103) of the camera device points in the direction of the road in front of the vehicle and a second beam path (108) points in the direction of the interior, preferably the driver.

16. The device according to one of Claims 14 through 15, characterized in that an illumination unit (121) that emits radiation that is at least largely invisible to the human eye, in particular infra-red radiation, is provided and can be controlled by the processing unit (110, 112).

17. The device according to one of Claims 14 through 16, characterized in that an infra-red filter (106) is arranged in the camera device (10), preferably in the second beam path (108) in the direction of the vehicle interior.

18. The device according to one of Claims 14 through 15,

characterized in that at least one light valve (151, 153), preferably a liquid crystal cell, is arranged in the camera device (10).

19. The device according to one of Claims 14 through 18, characterized in that at least one deviation mirror (102) that is preferably semi-transparent is arranged in the camera device (10).

20. The device according to one of Claims 14 through 19, characterized in that at least one deviation mirror (104) is designed to be concave (1041) or convex (1042).

21. The device according to one of Claims 14 through 20, characterized in that the camera device has a single camera (100), which is preferably designed as a CCD camera or a CMOS camera.

22. The device according to one of Claims 14 through 20, characterized in that the camera device (10) has at least two cameras for capturing images stereoscopically.

23. The device according to one of Claims 14 through 22, characterized in that the processing unit (110, 113) is connected to visual output units and/or acoustic output units (119, 21) which issue a warning to the driver, in particular if his eyes are closed or, respectively, the vehicle is about to move beyond a marked area of the road.

24. The device according to one of Claims 14 through 23, characterized in that the camera device (10) is arranged in an upper part of the windshield (12) or is integrated into the roof of the vehicle.

25. The device according to one of Claims 14 through 24, characterized in that at least one deviation mirror (104, 1041, 1042) can be adjusted by an adjustment device (130) so

that in an image of the vehicle interior captured by the camera device (10) at least the eyes and/or lips of the driver can be seen.

Abstract

A method and device for capturing the area surrounding and interior of a motor vehicle is described. The device for
5 carrying out the method includes a camera device (10) having a beam path (103) that points in the direction of the area surrounding the vehicle, in particular the road, and having a beam path (108) that points in the direction of the vehicle interior. A processing unit (110) controls and evaluates the
10 image information obtained.

Fig.1

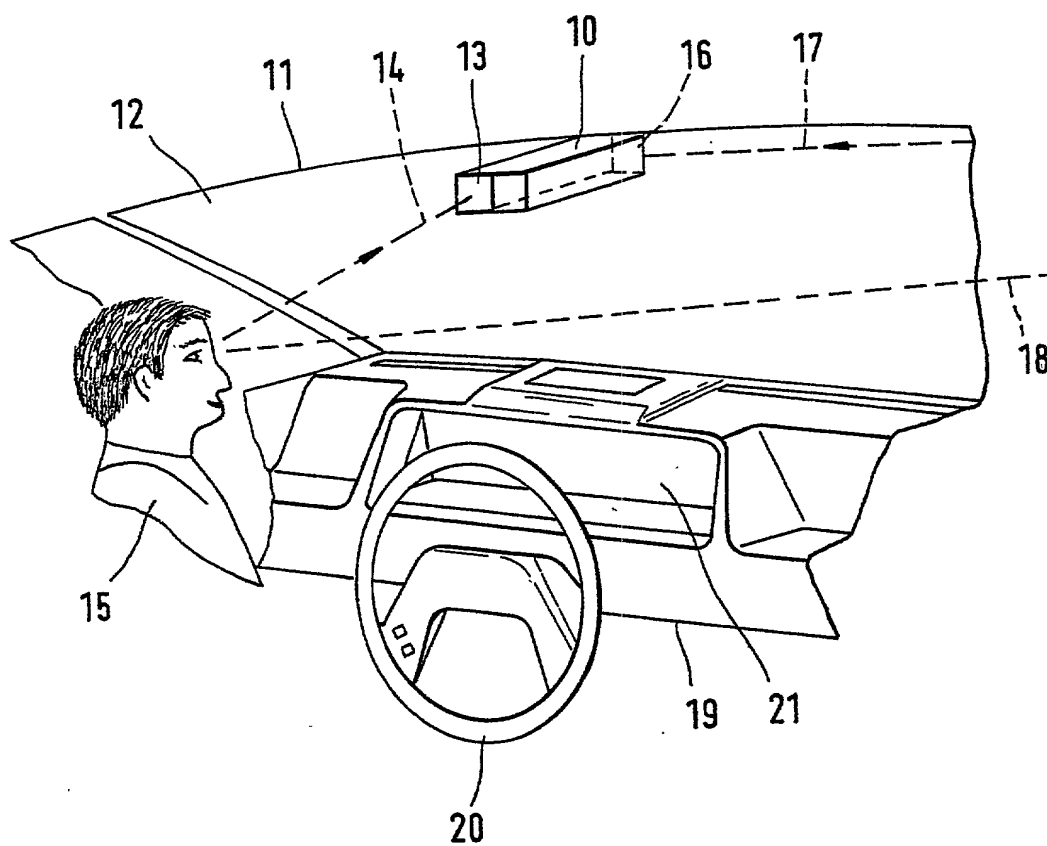


Fig.2

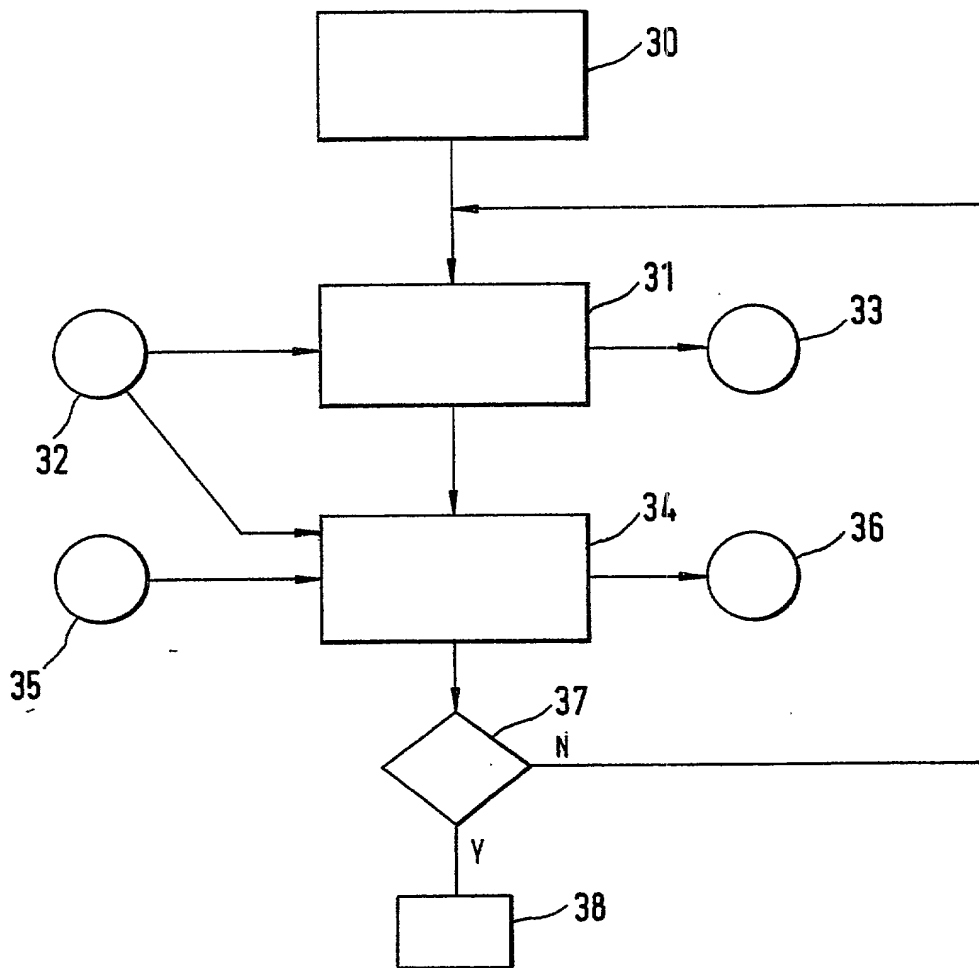


Fig.2a

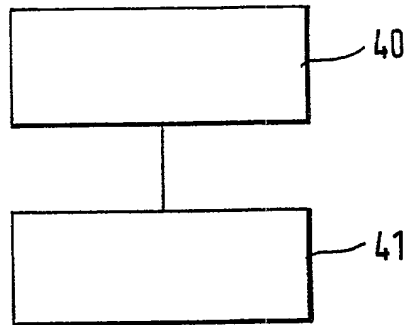


Fig.2b

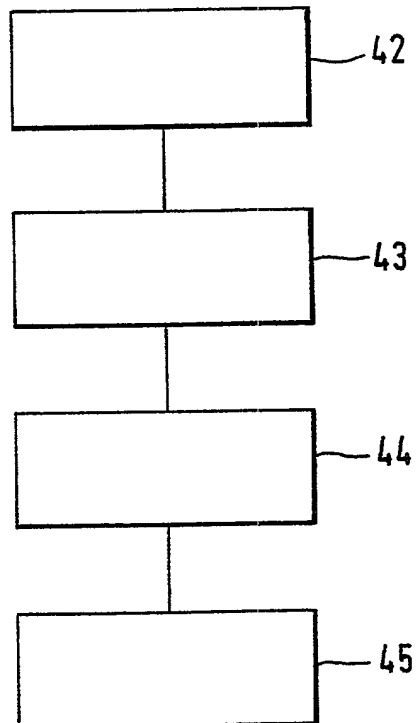


Fig.2c

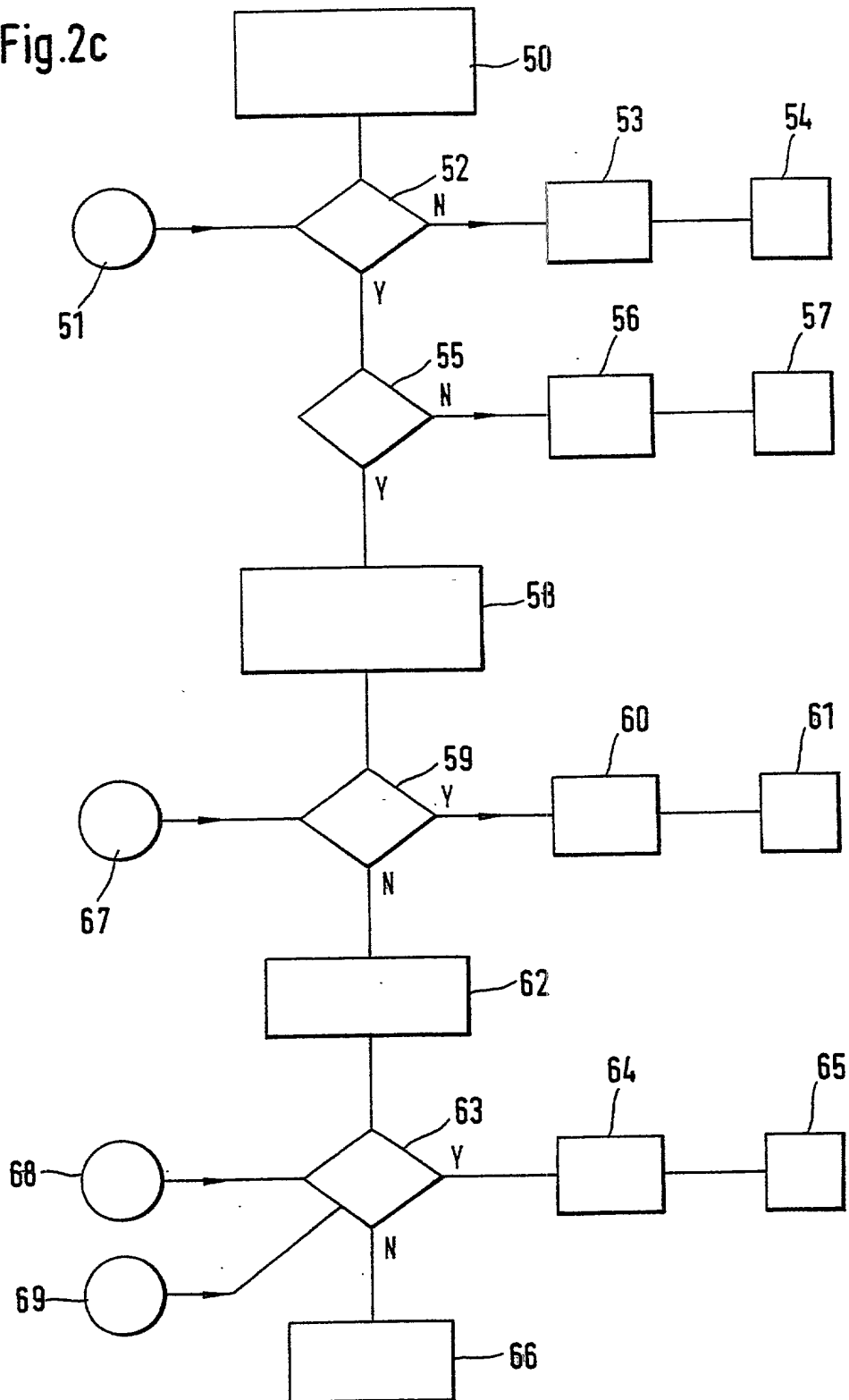
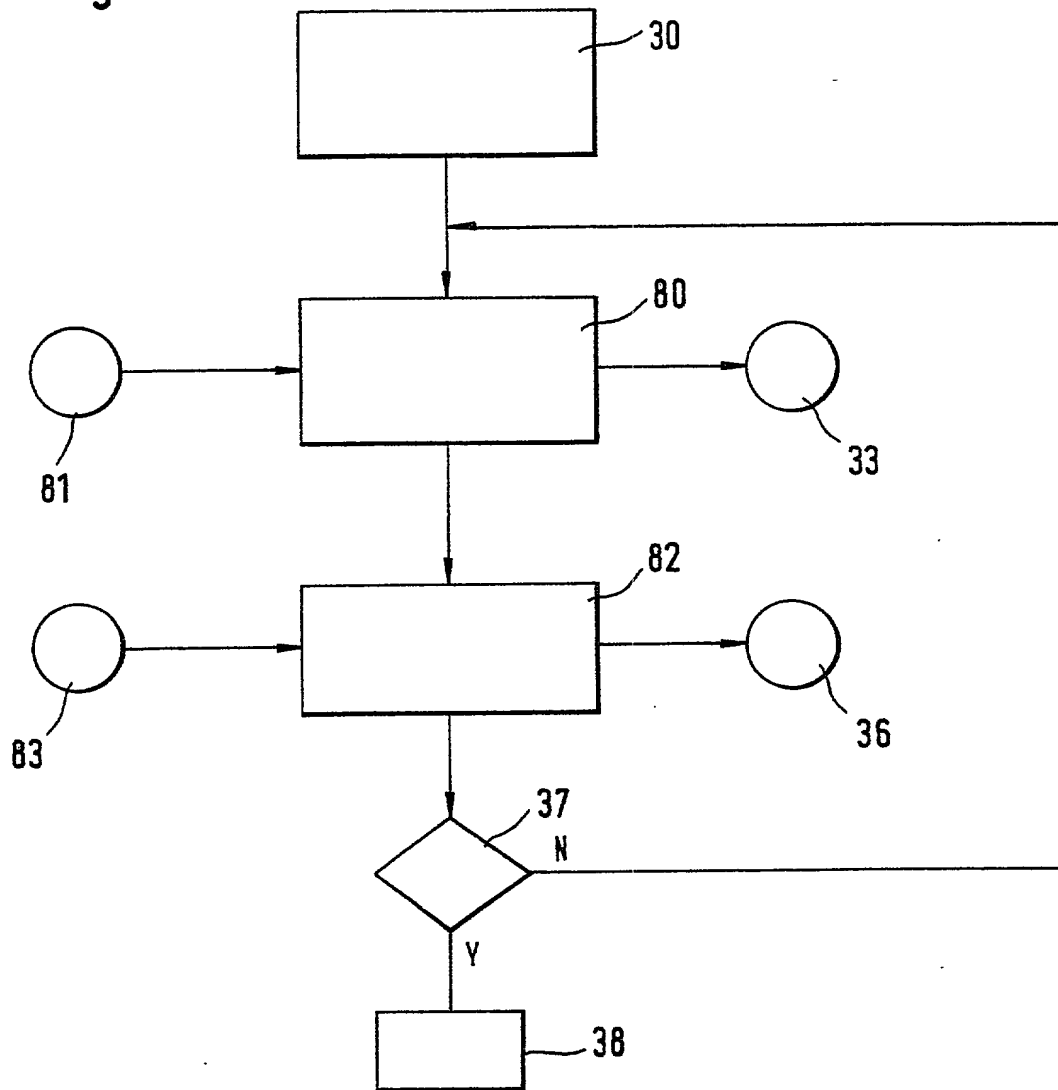


Fig.3



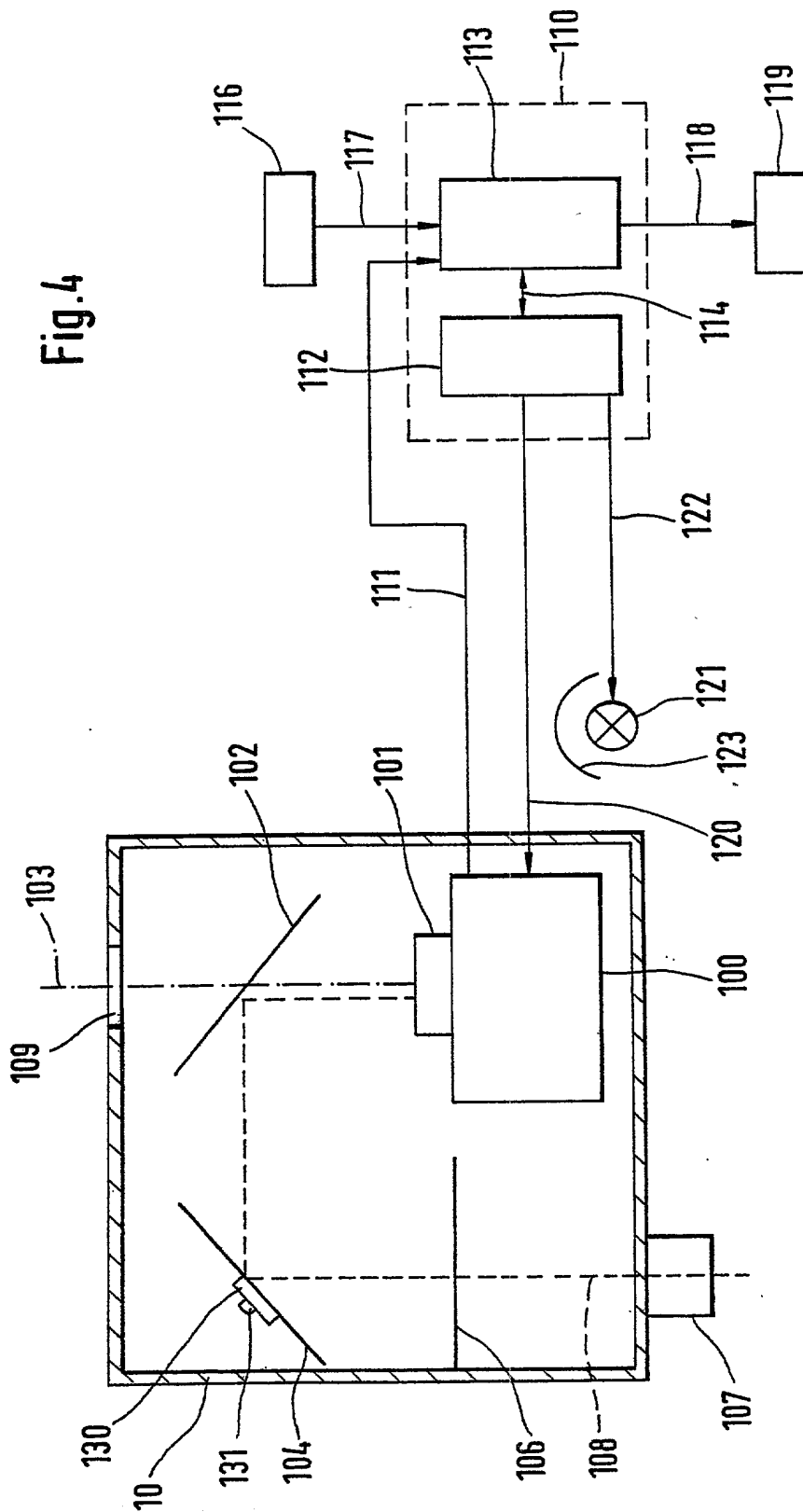


Fig.6

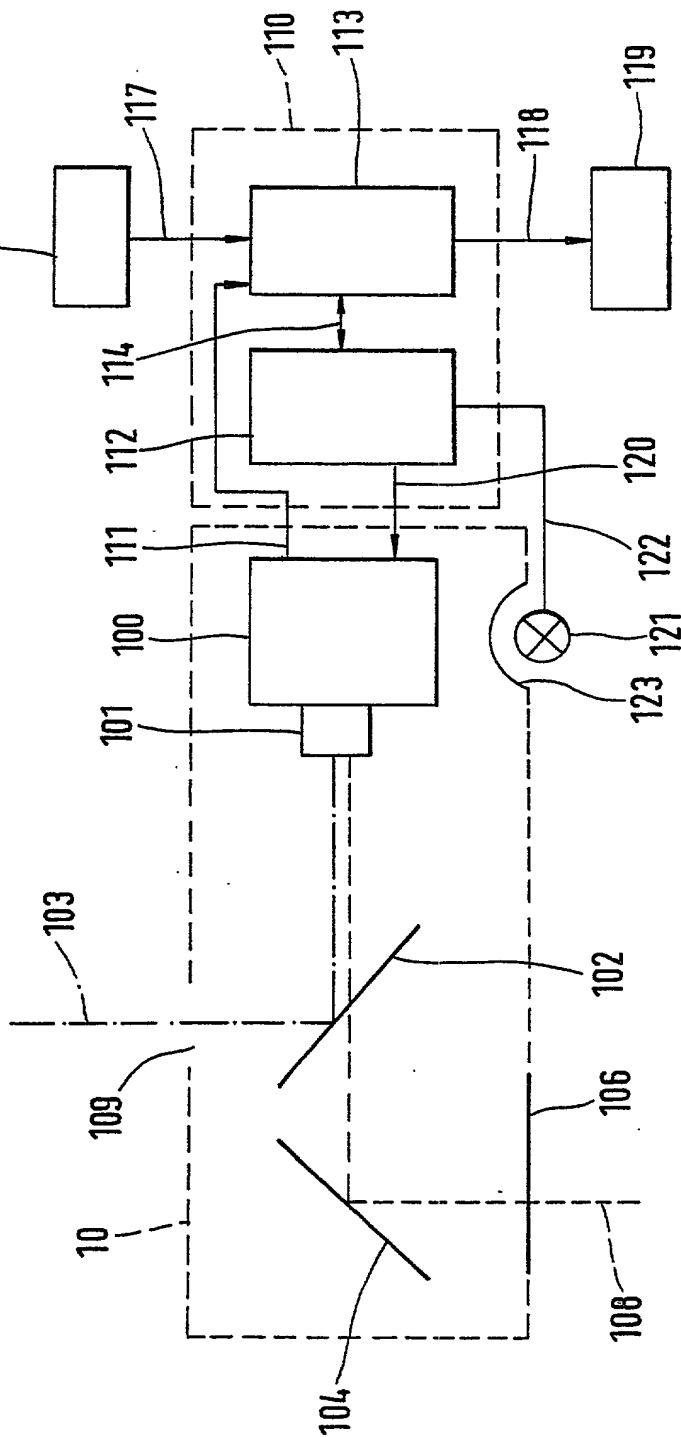
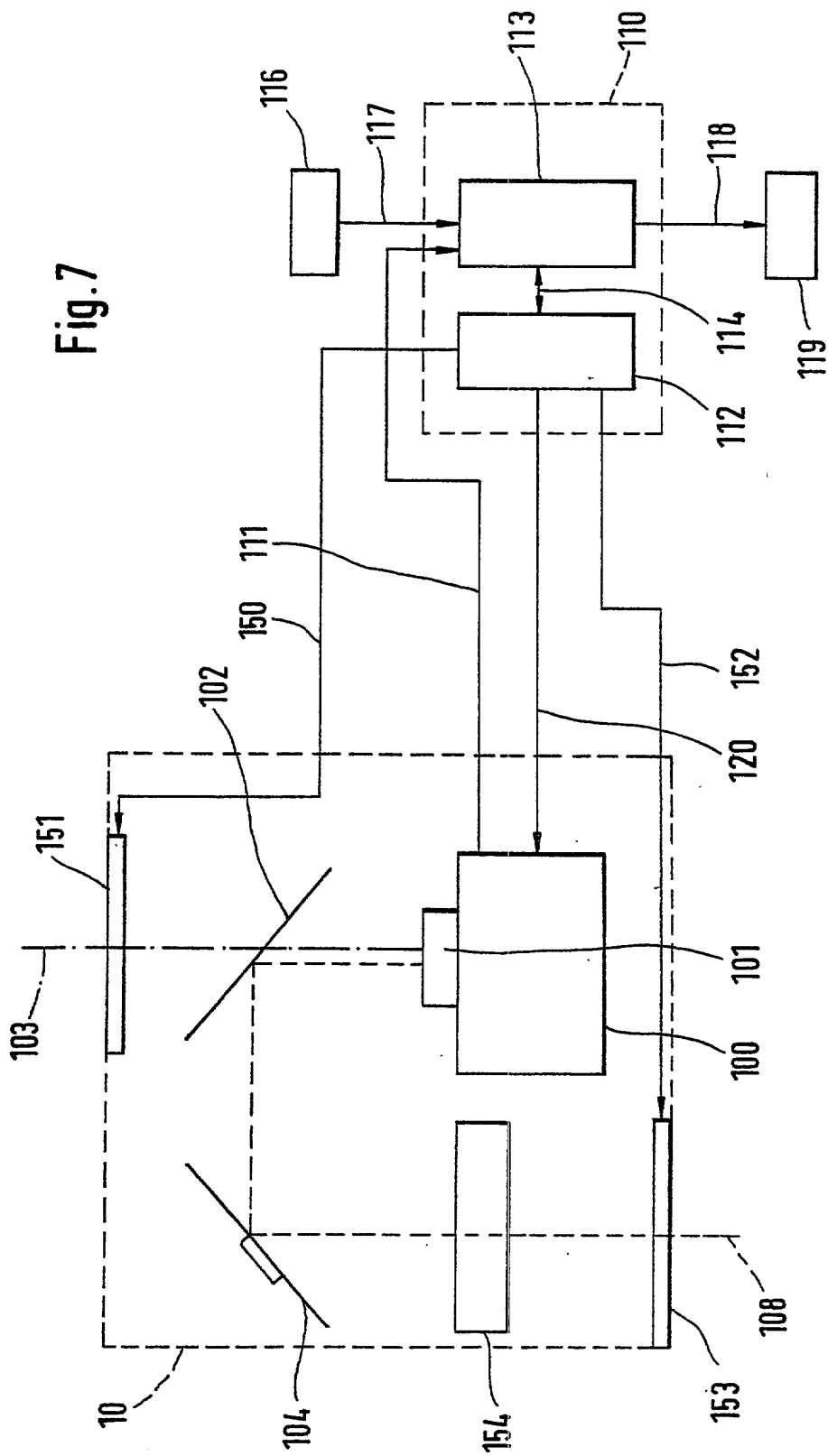


Fig. 7



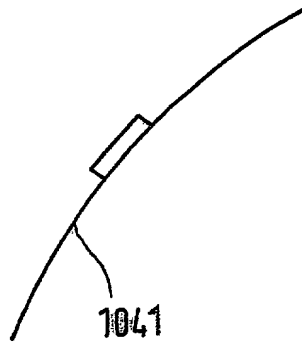


Fig. 8a

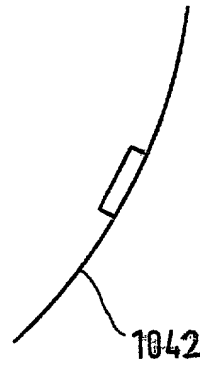


Fig. 8b

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[10191/1661]

COMBINED DECLARATION AND
POWER OF ATTORNEY FOR PATENT APPLICATION

As a below named inventor, I hereby declare that:

My residence, post office address and citizenship are as stated below adjacent to my name.

I believe I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention entitled

**METHOD AND DEVICE FOR MONITORING THE INTERIOR AND
SURROUNDING AREA OF A VEHICLE** and the specification of which:

- ☐ is attached hereto;
- ☐ was filed as United States Application Serial No. _____ on _____, 19__ and was amended by the Preliminary Amendment filed on _____, 19__.
- ☒ was filed as PCT International Application Number PCT/DE00/01426, on the 5th day of May, 2000.
- ☒ an English translation of which is filed herewith.

I hereby state that I have reviewed and understand the contents of the above-identified specification, including the claims, as amended by any amendment referred to above.

I acknowledge the duty to disclose information which is material to the examination of this application in accordance with Title 37, Code of Federal Regulations, §1.56(a). I hereby claim foreign priority benefits under Title 35, United States Code § 119 of any foreign application(s) for patent or inventor's certificate or of any PCT international applications(s) designating at least one country other than the United States of America listed below and have also identified below any foreign application(s) for patent or inventor's certificate or any PCT international application(s) designating at least one country other than the United States of America filed by me on the same subject matter having a filing date before that of the application(s) of which priority is claimed:

EL302 703331

**PRIOR FOREIGN/PCT APPLICATION(S)
AND ANY PRIORITY CLAIMS UNDER 35 U.S.C. § 119**

Country : Federal Republic of Germany

Application No. : 199 21 488.3

Date of Filing: May 8, 1999

Priority Claimed

Under 35 U.S.C. § 119 : ☒ Yes ☐ No

I hereby claim the benefit under Title 35, United States Code § 120 of any United States Application or PCT International Application designating the United States of America that is/are listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in that/those prior application(s) in the manner provided by the first paragraph of Title 35, United States Code § 112, I acknowledge the duty to disclose material information as defined in Title 37, Code of Federal Regulations § 1.56(a) which occurred between the filing date of the prior application(s) and the national or PCT international filing date of this application:

**PRIOR U.S. APPLICATIONS OR
PCT INTERNATIONAL APPLICATIONS
DESIGNATING THE U.S. FOR BENEFIT UNDER 35 U.S.C. § 120**

U.S. APPLICATIONS

Number :

Filing Date :

**PCT APPLICATIONS
DESIGNATING THE U.S.**


PCT Number :

PCT Filing Date :

I hereby appoint the following attorney(s) and/or agents to prosecute the above-identified application and transact all business in the Patent and Trademark Office

connected therewith.

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I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment or both under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issuing thereon.

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